INFORMATION REPORT

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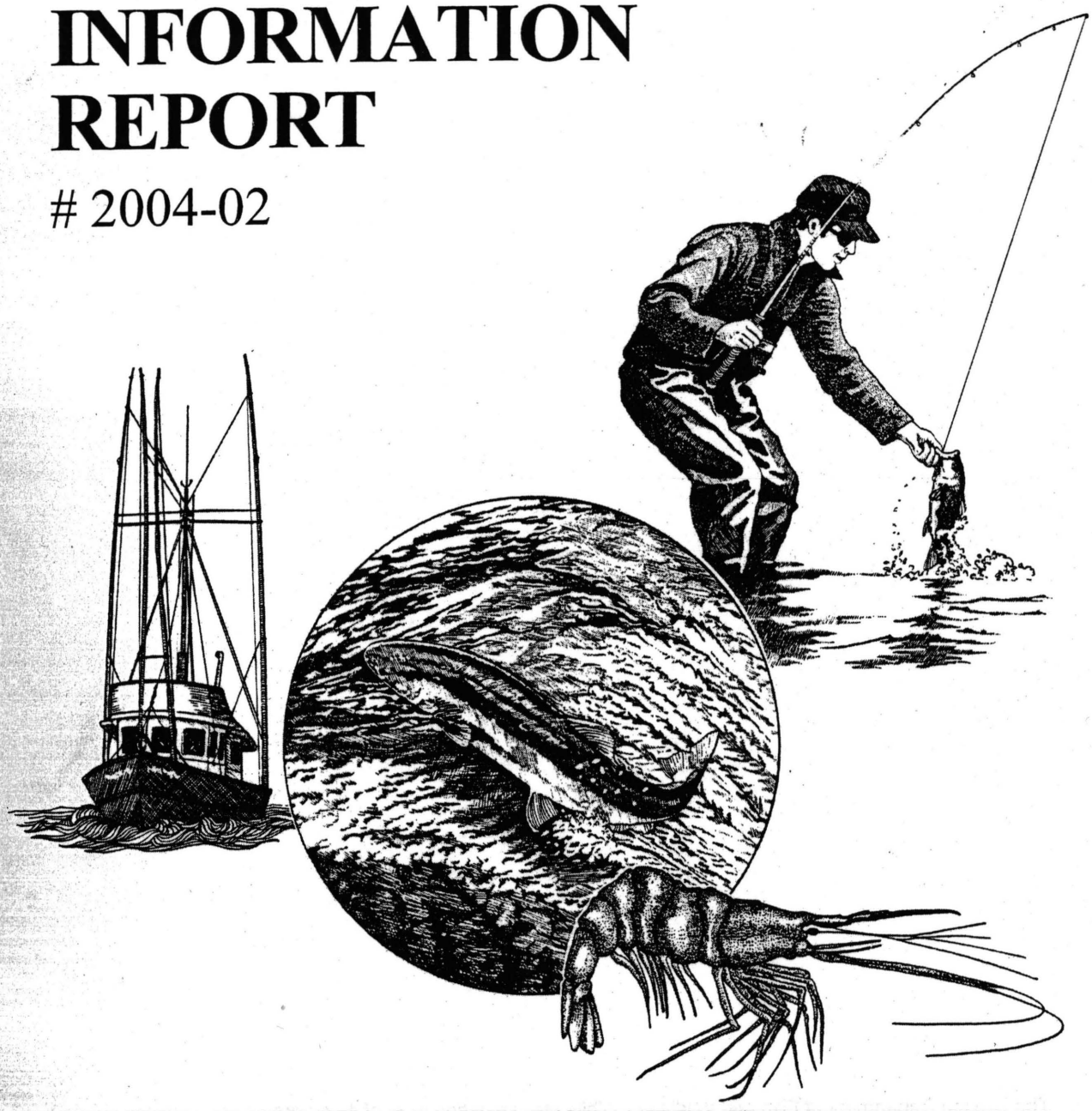

FISH DIVISION

Oregon Department of Fish and Wildlife

Stock Assessment of Elk River Fall Chinook Salmon for Exploitation Rate Analysis

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Abstract

Using various, research, and monitoring data from the Elk River, Curry County Oregon, estimates of the runsize of Fall Chinook Salmon were made for the period 1972-2001. These estimates could be allocated to either hatchery or wild origin fish and it was possible to construct the riverine harvest rates for each year. It is estimated that for large size Hatchery origin fish (>55cm), the run has varied from a low of 475 in 1981 to 10,821 in 2001. For wild reared Chinook the run has varied from a low of 1,166 in 1991 to 3,456 in 1999. Estimates of small sized Chinook (<55cm) are made but are believed to be less reliable than for large fish. This group of fish has been proposed as an Exploitation Rate Indicator Stock for use in the Coast Model as a representative of the harvest impact of ocean fisheries on wild Chinook populations from the Umpqua and Mid-South Gene Conservation (MOC) Groups composed of the Umpqua, Coos, Coquille, Sixes Rivers and Floras creek.

To prepare this stock for this role it was necessary to integrate the Port Orford Terminal Ocean fishery into the Elk River as none of the other populations are subjected to terminal fisheries. Using the annual estimated riverine harvest rates the recovery of Elk River ERI-stock Chinook in the Port Orford fishery beginning in mid-October until the end of the year were simulated as return to river and apportioned to catch or escapement. This information will now be available to the Chinook Technical Committee of the Pacific Salmon Commission to include the MOC group in the annual exploitation rate analysis. Additionally, this information can be used in the FRAM model for domestic ocean fishery management, and by local area managers for operational planning and fishery regulations in–river.

Acknowledgements

I'd like to acknowledge the extraordinary efforts of Gary Susac and Ken Flizar for their consistent efforts to maintain the monitoring program and the database of sampling results for many years. Mr. Susac collated the information and maintained the database throughout many years when little support was given the project. Sampling protocols necessary to make the appropriate estimates were maintained by these two biologists through their extraordinary work and many long hours of field work. I'd like to acknowledge the long list of biologists who had the foresight to begin the research studies that made the run reconstructions possible, among them are Paul Reimers, Al McGie, Jay Nicholas, Tim and Kay Downey, Reese Bender, and the many other staff that so diligently carried out the early research that is an invaluable tool to track this population of fall Chinook.

Introduction

The Oregon Department of Fish and Wildlife (ODFW) proposed using the Elk River Fall Chinook Stock as an Exploitation Rate Indicator (ERI)-stock for Oregon mid-coastal (MOC) wild stock aggregate of Chinook in the Coast Model (Williams, 2001). This model is used by the Chinook Technical Committee (CTC) of the Pacific Salmon Commission (PSC) to annually account for the harvest impacts of coastal ocean fisheries on naturally produced stocks of Chinook salmon. The Elk River domestic stock was chosen to represent naturally producing Chinook populations from 2 Gene Conservation Groups (GCG) as follows: Umpqua River GCG and the Mid-south GCG comprised of populations from the Coos, Coquille and Sixes Rivers, and Floras Creek. These stocks are aggregated into the MOC group for exploitation rate analysis, and the Coast Model. The Elk River ERI stock was derived from the native population in the Elk River, Curry County, Oregon. Broodstock is captured and spawned annually at the Elk River hatchery, located 8 miles upstream from the Pacific Ocean. Progeny are reared for about 9 months in the hatchery and then released into the Elk River in the fall to coincide with the first freshet; these fish are therefore classified as zero age, or ocean type smolts. To be useful in the analysis, ERI-stocks must be marked with an adipose clip and tagged with a coded micro-wire (Ad+CWT), so that they can be identified in ocean and riverine fisheries, and in the escapement, either to the hatchery or spawning grounds. Sufficient sampling must be conducted to estimate the total recovery of ERI-stock fish where they occur throughout their life history. Elk River domestic stock have been marked and CW-tagged beginning with the 1977 brood which was released from the hatchery in 1978. Since then, each year some of the production from the hatchery at Elk River has been Ad+CWT. Sampling has occurred in the river so that estimates of total escapement and fishery harvest can be made. However, to date these estimates have not been made or posted on the coast wide CWT database. This continuous tagging and recovery history allows us to accept this stock as an ERI-stock for the MOC aggregate for annual CTC analysis.

The MOC group and the Elk River ERI-stock have a number of population characteristics in common, among which is a higher early maturing rate than the other more northern Oregon

Coastal stocks (Table 1). The age 2 (1 salt) component of this group is always greater than in the more northern stock groups (Jacobs, et al. 20001, and 2002).

Table 1. Average Peak Spawner Index Counts by Stock Group of Oregon Coastal Fall Chinook. Gene Conservation Groups are: NE – Nehalem-Ecola, NOC – Mid-North, and MOC – Mid South.

Year	Gene Conservation Group	Large	Small	Small:Large Ratio
1996				
	N-E	56.8	1.1	0.02
	NOC	96.5	2.5	0.03
	MOC	100.6	4.6	**0.05**
1997				
	N-E	61.8	0.7	0.01
	NOC	50.5	1.8	0.04
	MOC	62.9	2.9	**0.05**
1998				
	N-E	50.8	0.9	0.02
	NOC	54.1	1.8	0.03
	MOC	100.8	4.3	**0.04**
1999				
	N-E	51.3	1.5	0.03
	NOC	58.8	2.7	0.05
	MOC	73.0	3.9	**0.05**
2000				
	N-E	42.3	1.7	0.04
	NOC	47.6	3.4	0.07
	MOC	68.0	6.3	**0.09**
2001				
	N-E	74.7	1.3	0.02
	NOC	99.2	6.5	0.07
	MOC	108.1	9.0	**0.08**

Because the probability of observing small (1 salt) fish during foot surveys is very low (Zhou, 2002), it is believed that there are many more small fish present than the foot surveys reveal. Because the more southern stocks have a higher early maturation schedule, it is important to account for these small fish in the run reconstruction and stock assessments. Often stock assessments will delete the small fish component because of the observational inefficiency of the surveys. However, because this age component is high in the MOC stock group it represents a substantial portion of the production of each cohort. Therefore, we will attempt to

account for this age group of the cohort in the annual run reconstruction from Elk River and apply the estimation parameters to the MOC group as a whole. Because the observational efficiency in spawning surveys is low there is more bias in estimates of small fish than of large fish.

Techniques have been developed to estimate annual returns of Chinook salmon to the Elk River (Williams, 2001, and Nicholas, and Downey, 1983). Fish entering the river on their spawning run are either caught in riverine sport fisheries, enter the hatchery for broodstock or spawn naturally. Each of these in-river destination strata have had some type of sampling for every year beginning in 1972. The intensity of sampling within each of the destination strata has not been consistent over the years, but generally the sampling is judged to be sufficient to allow a run reconstruction and a total accounting of the return of each Ad+CWT group beginning with the 1977 brood returns in 1981.

This paper will: develop and summarize the annual run reconstructions from 1972 to the present; develop techniques to estimate returns of each Ad+CWT group to the three destination strata between 1981-2000; and adjust the Ad+CWT returns to simulate tagged Chinook caught in the late season terminal troll fishery into the in-river fisheries as preparation for use in the Exploitation Rate Analysis used by the CTC.

Because the Elk River ERI-stock represents wild stocks from the mid-coast aggregate of Chinook populations, any target fishery operating only on the Elk River stock that does not occur on the wild stocks would cause this ERI-stock to bias the ocean exploitation rate for wild stocks it is supposed to represent. During most years, the ODFW allows a terminal ocean fishery to occur at the mouth of the Elk River in order to harvest surplus Chinook returning to the river. One of the primary objectives of the hatchery operation is to provide for surplus production for this terminal ocean fishery, called the Port Orford extended fishery. This fishery is predominated by a commercial troll fleet and occurs after the general ocean troll season ends on October 31st. There are no terminal late season fisheries allowed at the mouths of the Umpqua, Coos, Coquille or Sixes rivers. Generally, little troll fishing is done in the entire mid coast area after October 15th. Consequently, for the Elk River ERI-stock to truly represent the

harvest impacts of these other stocks we assumed that any Ad+CWT Chinook from Elk River that are caught in the Port Orford extended fishery would migrate into the river if they were not caught in this terminal ocean fishery. This simulated transfer of catch from the ocean then prepares the ERI-stock for use in the calculation of an ocean exploitation rate representative of the natural stocks in the MOC group. Furthermore, from our run reconstruction we can estimate the in-river harvest and escapement and thereby obtain a total brood exploitation rate for these natural stocks. Domestic managers can also use the exploitation rate information to determine if the harvest regimes are meeting the Oregon's Chinook Management plan goals.

Methods

Coded micro-wire tagging history

Groups of Chinook salmon at the Elk River hatchery were Ad+CWT tagged for experimental and production monitoring purposes. Between the 1977 and 1989 broods most lots were approximately 25,000 to 30,000 in size, although for several brood years larger numbers were also tagged. Beginning with the 1990 brood 200,000 Chinook were Ad+CWT tagged as per CTC requirements for exploitation rate indicator groups. All tagging information is presented in this report.

Run Reconstruction

Sampling Protocol

Beginning in 1970 extensive sampling of the returning run of Chinook was conducted by the research and development section of ODFW, for a period of ten years. This research study among other tasks provided a run size estimate based on a mark- recapture experiment, a statistical creel survey (1972-80), and collection of broodstock at the hatchery. From 1981-1992 the research efforts were decreased and provided for collection of standardized samples from the spawning grounds, census of fish returning to the hatchery, and intermittent samples from the fishery to determine wild:hatchery ratios, and age composition of the catch. Because a full creel survey was not implemented during these years a direct estimate of catch could not be derived in the same manner as during the 1972-80 period. However, a statewide standard catch accounting program is able to provide catch estimates for this period. The procedure is based on voluntary angler reporting called the "punch card" system. As anglers land fish they

are required to record their catch on a catch reporting card. At the end of the fishing year each angler is asked to return these catch cards to the department for estimating the catch in each river in the state. Because not all anglers submit their catch card a non-response bias expansion factor is applied to estimate the final catch for each river. Naturally, this estimation procedure uses a different estimation technique than the river specific creel survey previously conducted. Beginning in 1992 when the ODFW designated the Elk River hatchery stock as an ERIS, another statistical creel survey was implemented and continues annually.

Throughout the period 1980 to the present the agency continued to collect all fish entering the hatchery for broodstock and sampled all fish. Annually the agency also maintained a standardized spawner sampling program so that calibration values derived during the mark recapture period could be applied to annually estimate the return to river. ODFW also maintains a standard fishery sampling program for all ocean fisheries which includes the late season Port Orford troll fishery. For both freshwater and ocean fishery sampling, fish are checked for gender, length, and mark status. If any sample has a missing adipose fin the snout was taken for Coded Wire Tag analysis. Hatchery reared fish returning during the 1970-80 period could be identified easily as all hatchery releases were fin marked. The run estimation was therefore stratified into hatchery and wild origin fish. After 1980 not all releases were fin marked and the hatchery:wild ratios were determined by scale pattern analysis. Naturally reared populations from the Elk River have unique scale patterns that can be used to discriminate the rearing origin of the fish. Throughout the entire monitoring period scale collection and analysis has always been an integral part of the annual sampling protocol. The use of the term wild fish in the Elk River refers to fish that were reared in the natural habitat as opposed to the hatchery, it in no way infers genetic composition of the fish. Chinook reared in the wild could be from a hatchery:hatchery cross, a hatchery:wild cross or wild:wild cross. The definition of wild in this paper is derived solely from scale pattern analysis.

Catch

Creel surveys conducted from 1972-1980 are reported in Reimers, et al, (1981), and Nicholas and Downey, (1983). These surveys were conducted with one creel clerk, and a sample design using car counts and angler interviews. There are no variances reported with these estimates.

The punch card data are available on the agency web site as well as from the ODFW Fish Information section in the headquarters office. Creel surveys again were conducted in 1990 and then beginning in 1992 to the present. The surveys beginning in 1992 are based on a different sample design from the earlier creel surveys. Currently up to 4 creel clerks are used to cover the fishery during peak angling periods. Pressure counts are made from a boat in the areas that are predominated by boat anglers, while vehicles are used to access areas predominated by shore anglers. Car counts are used only for periods when inclement weather prevents use of the boat. No published reports are available for the annual catch estimates for the period 1992-2000, however these records are kept on agency electronic media at the Gold Beach and Marine Resources program servers. Catch estimation techniques for the period 1992 – 2000 are from Jacobs and Boechler, (1987). All creel surveys estimated 2 size classes of fish in the harvest, small fish less than 55 cm, and large fish greater than 55 cm. Generally, all small fish are age 2 (one salt) males. The Punch Card database only lists large fish greater than 24 inches. The catch estimates for all years can be classified by origin from scale analysis. The resulting harvest statistics are then denoted as:

C_{lhy} = Harvest estimate of large hatchery origin fish from in year y;

C_{lwy} = Harvest estimate of large wild origin fish from in year y;

Where:

C = Estimated catch;

y = run year;

l = subscript denoting a large (>55cm) fish;

h = hatchery origin;

w = wild origin;

Compare Catch Estimates to Detect Bias in Punch Card Estimate

Because the dataset is composed of 2 distinct types of catch estimation methods (creel survey and punch card estimates) a comparison was made during the years when both estimates were available to determine if there is a systematic bias. If bias is detected the Punch Card estimate will be adjusted to conform to the creel estimates, as the creel estimates are felt to be a better measure of the true catch. The analysis uses only the catch data from 1978-2000 as the older Punch Card data included small as well as large fish.

Because the Punch Card data does not include small fish, it was necessary to estimate the harvest of small fish during years when no creel surveys were conducted. Two methods of estimating the catch of small fish were used depending whether random angler interviews were conducted or no interviews were conducted. Between 1981 and 1985 and in 1991 numerous consistent random angler interviews were made to determine the ratios of small to large fish and hatchery to wild fish. For the years 1982-85 the catch of small fish was estimated by using the Punch Card estimate of large fish multiplied by the small to large ratio from angler interviews.

$$C_{sy} = C_{ly} (c_{sy} / c_{ly}) \qquad (1.0)$$

Where:

s = subscript denoting a small (<55cm) fish;

C_{sy} = Estimated riverine harvest of small fish (<55cm) in year y;

C_{ly} = Estimated riverine harvest of large fish from the Punch Card database in year y;

c_{sy} = Observed number of small fish counted in the angler interviews in year y;

c_{ly} = Observed number of large fish counted in the angler interviews in year y.

For the period 1986-89 when no angler interviews were made, the average small to large ratio for the period 1992-2000 was used for each of these years.

Estimates of the harvest of hatchery origin fish can be made from scales collected during the creel surveys or during the angler interviews. For the period 1985-89 when no interviews were conducted the 1992-2000 average hatchery to wild ratio was used.

Hatchery Recovery

A passive fish trap is located at the downstream end of the Elk River fish hatchery site. Migrating fish can voluntarily enter the fish ladder and progress up the ladder until trapped. All migrating fish do not enter the ladder, and often a majority of fish continue up river to spawn naturally. All trapped fish are counted and held for broodstock. Records of gender, length and mark status are made and scales collected to verify age and juvenile life history, all fish with missing adipose fins are processed to determine the tag code. Scales of the unmarked fish are

analyzed to determine origin and age. The result is a total count of both hatchery origin Chinook (H_{hy}) and wild Chinook (H_{wy}).

where:

H_{hy} = total count of hatchery origin Chinook taken in the hatchery in run year y;

H_{wy} = total count of wild origin Chinook taken in the hatchery in run year y.

Because all fish entering the hatchery are used in the breeding program all CW-tagged Chinook are decoded and entered on the Pacific States Marine Fisheries Commission (PSMFC) RMIS-database resulting in a total number of fish by tag code - H_{ty}

where:

t = an individual tag code, and

H_{ty} = the total number of a particular tag code (t) captured in the hatchery in year y.

Spawning Ground Recovery

The mark recapture experiment designed a comprehensive sampling plan to survey an extensive amount of the spawning grounds in order to recapture marked fish. After the ten year study period the annual monitoring protocol has always maintained a similar extensive survey plan. Therefore, the spawning ground samples are relatively consistent for all years that are used in the exploitation rate analysis. Annual run reconstruction depends on the number of wild and hatchery origin fish recovered on the spawning surveys and therefore the survey protocol must remain consistent to validate the run estimation.

Several authors have used the mark recapture data to derive a technique to estimate the annual run size and spawning escapement. Nicholas and Downey, (1983), used a linear model to predict the run size of large fish (>55 cm) using the sum of the carcasses counted on all standard spawning surveys. They found that this variable was suitably correlated with the run size to be able to estimate the total number of spawners annually if the standard survey protocol was followed. Williams, (2001), reviewed their work and suggested a power function to provide an improved predictor model for estimating the number of fish escaping to spawn

naturally. Along with the annual census of fish returning to the hatchery and the estimated catch, the annual run to the river of fall Chinook can be estimated.

The function used to estimate hatchery origin large spawners is:

$$S_{lhy} = 7.76(s_{lhy})^{0.9925} \qquad (2.0)$$

where:

S_{lhy} =Estimated number of large hatchery origin spawners;

s_{lhy} = Observed number of large hatchery origin carcasses found during the season on all standard spawning surveys.

The function used to estimate wild origin large spawners is:

$$S_{lwy} = 300.59*(s_{lwy})^{0.327} \qquad (2.1)$$

where:

S_{lwy} = Estimated number of large wild origin spawners.

s_{lwy} = Observed number of large wild origin carcasses found during the season on all standard spawning surveys.

In the case of small (<55 cm) fish, few are observed on spawning surveys and are believed to under-represent the true number of small fish present. The research study was unable to find a reliable index from the spawning ground surveys and relied upon the ratio of small to large fish as determined from sampling the fishery. Fishery surveys have not been consistent throughout the years, however the hatchery returns are always sampled annually. Therefore, this analysis uses the annual ratio of small to large fish from the hatchery returns every year combined with the ratio from the fishery, whenever the fishery is sampled. The estimated large fish spawners are multiplied by the ratio of small to large fish to estimate the number of small fish on the spawning grounds.

$$S_{sy} = S_{ly}\,[(H_{sy} + c_{sy})\,/(H_{ly} + c_{ly})] \qquad (2.2)$$

where:

S_{sy} = Estimate of small (<55 cm) fish on spawning grounds in year y

S_{ly} = Estimate of large fish on spawning grounds in year y,

H_{sy} = Number of small fish counted in the hatchery return in year y,

c_{sy} = Observed number of small fish counted in the angler interviews in year y,

H_{ly} = Number of large fish counted in the hatchery return in year y.

c_{ly} = Observed number of large fish counted in the angler interviews in year y.

For the run reconstruction this can be done for both wild and hatchery fish, although only the hatchery estimates will be used in the accounting of CW-tagged fish for the exploitation rate analysis.

Run Size Estimation

Annual run reconstructions then sum the following three destination strata for both wild and hatchery origin Chinook: estimated catch, hatchery return, and estimated spawners to estimate the total ocean escapement to the Elk River:

$$R_{hy} = (\mathbf{C}_{lhy} + \mathbf{C}_{shy}) + (H_{lhy} + H_{shy}) + (\mathbf{S}_{lhy} + \mathbf{S}_{shy}) \qquad (3.0)$$

$$R_{wy} = (\mathbf{C}_{lwy} + \mathbf{C}_{swy}) + (H_{lwy} + H_{swy}) + (\mathbf{S}_{lwy} + \mathbf{S}_{swy}) \qquad (3.1).$$

where:

R_{hy} = Estimated run to river of Hatchery origin Chinook;

R_{wy} = Estimated run to river of Wild origin Chinook.

Because both the run as well as the sampling is stratified by hatchery and wild origin fish, it is possible to then estimate the number of ERI-stock in the run using the hatchery run reconstruction statistics. In the case of the ERI-stock we are interested only in the Ad+CWT-tagged fish to match with these same cohorts recorded in the ocean fisheries. The CWT recovery information is available from the Pacific States Marine Fisheries Commission RMIS database.

For run years 1992-2000 all three destination strata are sampled and sample fractions for each strata provide the expansion factors to apply to the Ad+CWT samples. In the case of the fish counted in the hatchery trap the expansion factor is 1, as all fish are counted. This has been the case for all years since 1970. For recoveries of ERI-stock Chinook in the riverine fishery, only those years when creel surveys were conducted have estimates been made. This report will

develop the estimates for the other years (1981-91). For fish spawning naturally, the estimates have not been submitted to the PSMFC for any year, and are developed in this report.

Estimation of ERI-stock recoveries on spawning grounds

For the spawning ground surveys we use the power function (2.0) for large (>55 cm) fish to calculate the estimated number of an individual tag code on the spawning grounds:

$$S_{ty} = 7.76*(s_{ty})^{0.9925} \qquad (2.3)$$

where:

t = an individual tag code

S_{ty} = the total number of a particular tag code (t) estimated to have escaped to spawn naturally; and

s_{ty} = Observed number of samples of tag code (t) found during all spawning surveys.

Procedures used to expand the spawning escapement of small CWT fish

During spawning surveys a few small (<55 cm) fish are found and checked for presence of CW-tags. Because the total estimate of small fish does not use these samples as a basis for the estimate, when we apply these recoveries to estimate the total number of tagged small fish present on the spawning grounds the sample fraction is quite small making the CWT expansion factor quite large. The under representation of sampled small Chinook on the spawning grounds was found to occur in other rivers along the Oregon coast where mark recapture experiments are conducted (Nuzum and Williams, 1991; Zhou 2002). The author felt that these estimates are very uncertain and suggest truncating any expansion factor to 100:1. This is similar to the expansion limits used by the CTC when small samples are encountered. They use a 50:1 as the upper limit to the expansion in ocean fisheries. Since we know that small fish are very difficult to observe on the spawning ground it is felt that 100:1 is warranted, although quite arbitrary.

Estimating Catch of tagged (ERI-stock) Chinook

For the catch, the sample fractions derived from each area/angler type stratum from the creel survey provides the expansion factor for each tag code in that fishery stratum. The resulting estimates of total catch by tag code have been reported to the PSMFC database. However, for

years when no creel surveys were conducted estimates have not been made, and this paper will provide estimates that need to be integrated into the exploitation rate analysis.

For run years 1981-1991 when no creel surveys were made the number of tagged fish that were caught is estimated using a four stage process. The first stage is to estimate the harvest rate derived from the run reconstruction.

$$HR_{hy} = \mathbf{C}_{hy} / R_{hy} \qquad (4.0)$$

where:

HR_{hy} = Harvest rate of hatchery origin fish from the run reconstruction.

$\mathbf{C}_{hy}$ = Estimated catch of hatchery origin fish from the punch card records;

The second stage is to estimate the number of hatchery origin ERIS Chinook in the run annually when no creel surveys were made. The sum of the number of all hatchery take ERI-stock, plus the sum of the estimated spawning ground ERI-stock fish divided by (1- harvest rate) is used to estimate the total run of ERI-stock fish in year y:

$$\sum_{t}^{t=1...n} R_{ty} = [\sum_{t}^{t=1...n} (H_{ty} + \mathbf{S}_{ty})]/(1 - HR_{hy}) \qquad (4.1)$$

where:

R_{ty} = Estimated run of CW-tagged (ERI-stock) Chinook with tag code t in year y;

H_{ty} = Number of CW-tagged (ERI-stock) Chinook taken in the Hatchery in year y;

$\mathbf{S}_{ty}$ = Estimated Number of CW-tagged (ERI-stock) Chinook spawning naturally in year y.

The third stage is to estimate the total catch of ERI-stock Chinook by subtracting the escapement of ERIS from the run of ERIS.

$$\sum_{t}^{t=1..n} \mathbf{C}_{ty} = \sum_{t}^{t=1...n} R_{ty} - \sum_{t}^{t=1...n} (H_{ty} + \mathbf{S}_{ty}) \qquad (4.2)$$

where:

$\mathbf{C}_{ty}$ = Estimated number of Chinook with tag code t in the catch for year y;

The fourth stage is to apportion the CW-tagged (ERI-stock) Chinook taken in the fishery by individual tag coded fish as determined by the proportion of each tag code sampled in recoveries from all strata that were sampled each year.

$$\mathbf{C}_{ty} = \sum_{t}^{t=1..n} \mathbf{C}_{ty} * [r_{ty} / \sum_{t}^{t=1...n} (r_{ty})] \qquad (4.3)$$

where:

r_{ty} = Observed number of Chinook with tag code t sampled in all 3 strata in year y.

The estimated total recovery of each tag coded Chinook (ERI-stock) in the in-river run is simply the sum of the three components, catch, hatchery take, and spawning grounds.

$$R_{ty} = \mathbf{C}_{ty} + (H_{ty} + \mathbf{S}_{ty}) \qquad (4.4)$$

The in river recovery of Chinook by tag code is expressed as either catch ($\mathbf{C}_{ty}$), or escapement ($H_{ty} + \mathbf{S}_{ty}$), for purposes of integrating the Port Orford Terminal Ocean fishery in the in-river run.

Integrate the Port Orford Terminal Troll catch of Ad+CWT Tagged fish into the In-river Run.

To simulate the condition in the MOC wild stocks with the Elk River ERIS the tagged Elk River fish captured in the terminal Port Orford Troll fishery after week 42 are allocated to the in-river catch or escapement based on the run year in-river harvest rate.

$$POC_{ty} = PO_{ty} * HR_{hy} \qquad (5.0)$$

where:

POC_{yt} = Simulated in-river catch of the tagged ERIS fish that were actually captured in the late season terminal troll fishery at Port Orford.

PO_{ty} = Actual catch of the tagged ERIS fish captured in the late season (after week 42) terminal troll fishery at Port Orford.

The simulated escapement is then:

$$POE_{ty} = PO_{ty} - POC_{ty} \qquad (5.1)$$

where:

POE_{ty}= Simulated in-river escapement of the tagged ERIS fish that were actually captured in the late season terminal troll fishery at Port Orford.

The number of Ad+CWT fish captured in the late season Port Orford fishery is summarized in the Pacific States Marine Fisheries Commission RMIS database and can be queried via the TD-5 report using location codes:

5M222 38053805_10 ..... Troll Fishery Humbug to Blanco

5M222 38063806_10 ..... Troll Fishery South of Humbug

5M222 38053805_11 ..... Sport Fishery

The simulated in-river run then is the sum of the three simulated destination components:

$$R_{ty} = C_{ty} + POC_{ty} + H_{ty} + \mathbf{S}_{ty} + POE_{ty} \qquad (6.0)$$

The simulated in-river catch and escapement of this ERIS can then be used in the exploitation rate analysis to correct for the unique terminal fishery for this stock at Port Orford. The corrected ocean exploitation rate in the analysis will then appropriately represent the wild stocks in the MOC aggregate.

Results

Tagging History

Table 2. Coded micro-wire tagging of Elk River Fall Chinook Salmon 1977-2000 broods.

Brood Year	Tag Code	Number of Ad+CWT	Brood Year	Tag Code	Number of Ad+CWT
1977	071646	28,636	1991	074009	32,302
1978	072008	26,978	1991	074010	30,898
1979	072242	26,517	1991	074948	27,672
1979	072243	25,945	1991	074953	34,807
1979	072244	26,173	1991	074951	31,716
1979	072245	25,479	1992	070422	53,509
1980	072535	14,405	1992	070423	36,278
1980	072536	14,993	1992	070424	35,468
1980	072537	15,167	1992	070425	31,475
1980	072538	15,143	1992	070426	34,191
1981	072562	27,158	1993	070521	38,190
1981	072602	27,105	1993	070522	37,690
1982	072723	25,200	1993	070523	36,060
1983	072916	26,394	1993	070524	36,155
1984	072920	26,424	1993	070525	39,120
1985	072924	25,361	1994	070854	194,243
1986	072937	23,389	1995	070951	174,479
1987	074415	25,276	1996	092148	175,967
1988	074833	27,315	1997	091857	25,504
1989	075423	27,315	1997	092449	163,690
1990	075663	37,216	1998	092810	193,648
1990	075701	35,168	1999	093052	198,583
1990	075702	33,859	2000	075941	198,756
1990	075703	34,621			
1990	075704	34,753			

Run Reconstruction

Compare punch card to creel estimates of catch

The relationship between the Punch Card and creel survey catch estimates shows 2 different patterns depending on the period used in the comparison (Figure 1). For the years 1978-95, on average, the punch card estimate was 2.1 times greater than the creel estimate, with a coefficient of variation of 50%. For the period 1996-1999, on average, the punch card estimate

was about 0.94 of the creel estimate with a CV of 16%. It appears that for the earlier period the punch card estimates may not be very reliable, and on average were about twice the creel survey estimates until 1996. The response adjustment factors for the punch card estimates have changed over time and thought to have been different for the system in the earlier period. Therefore, I adjusted the Punch card catch data by half for the period 1981-89 and in 1991.

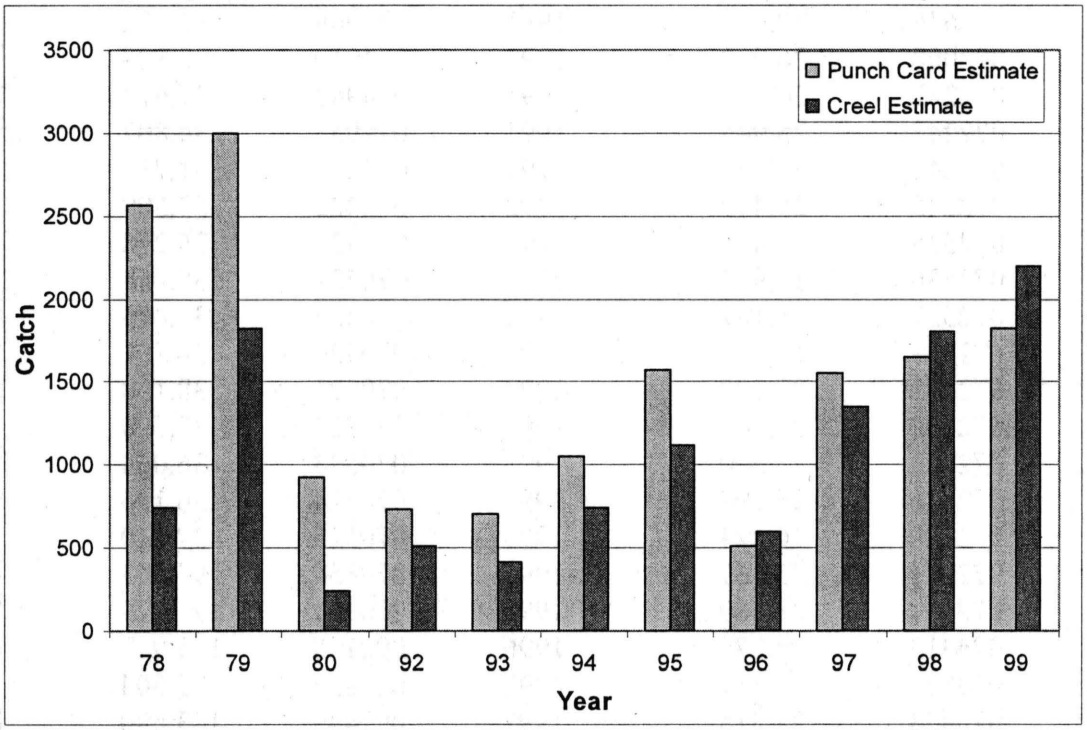

Figure 1. Comparison of the Punch Card and Creel Survey Chinook Catch Estimates in the Elk River. Data from 1978 - 80 was from the Calibration study. Data from 1992 -2000 from the Run Reconstruction Monitoring.

Catch estimates in Elk River

Catch estimates are needed for the period when the ERI-stock returned to the river. This period began in 1980 when the three year old fish of the 1977 brood returned. In 1980 and in 1990 statistical creel surveys were conducted, however, for other years until 1992 only punch card estimates are available. A summary of catch estimates for the entire period since the hatchery fish began to return in 1972 is provided to serve as a data source for this stock. Through either juvenile marking, or scale analysis the catch can be stratified into hatchery or wild origin fish.

Table 3. Catch Estimates of Fall Chinook Salmon in Elk River, Curry County, Oregon, 1972 – 2001. Percent small from creel surveys 1972-80 and 1990, or from angler interviews 1981-91. Adjustments were to correct bias in punch card data.

Run	Creel Surveys		Punch Cards	Adjusted	Estimated	Percent
Year	Large	Small	Large	Large	Small	Small
1972	391	1684	313			81.2
1973	289	2152	163			88.2
1974	2128	343	1848			13.9
1975	2446	1154	2496			32.1
1976	596	2427	561			80.3
1977	2357	1144	2860			32.7
1978	738	133	2561			15.3
1979	1826	94	3003			4.9
1980	238	482	925			66.9
1981	na	na	527	264	801	75.3
1982	na	na	1574	787	2290	74.4
1983	na	na	2003	1002	145	12.6
1984	na	na	1647	824	549	40.0
1985	na	na	956	478	2675	84.8
1986	na	na	1368	684	142	17.1
1987	na	na	3731	1866	385	17.1
1988	na	na	3167	1584	327	17.1
1989	na	na	1680	840	174	17.1
1990	369	66	739	---	---	15.2
1991	na	na	488	244	31	11.4
1992	514	214	736			29.7
1993	410	201	701			7.2
1994	739	341	1051			31.6
1995	1106	434	1572			27.2
1996	572	213	507			26.3
1997	1349	328	1552			19.2
1998	1806	55	1644			3.0
1999	2196	363	1826			14.2
2000	1931	361	931			15.8
2001	2431	251	3076			9.4

Table 4. Catch estimates of fall Chinook in Elk River, Curry County, Oregon, 1972 to 2001, allocated by origin. Percent by origin from creel surveys 1972-80 and 1990, from angler interviews 1981-91.

	Large Fish			Small Fish		
Run	Percent	Estimated Number		Percent	Estimated Number	
Year	Hatchery	Wild	Hatchery	Hatchery	Wild	Hatchery
1972	75.0	98	293	81.0	320	1364
1973	80.0	58	231	81.3	402	1750
1974	85.0	320	1808	45.1	188	155
1975	81.0	466	1980	26.5	849	305
1976	63.7	216	380	73.5	644	1783
1977	80.9	450	1907	73.0	309	835
1978	50.3	367	371	34.6	87	46
1979	56.4	796	1030	58.3	39	55
1980	38.5	146	92	22.4	374	108
1981	24.5	200	64	93.8	49	752
1982	59.2	321	466	98.2	40	2250
1983	86.1	139	863	63.3	53	92
1984	75.5	202	622	79.7	112	437
1985	73.1	128	350	93.9	163	2512
1986	76.2	230	454	84.7	22	120
1987	75.1	628	1238	84.7	59	326
1988	73.1	533	1051	84.7	50	277
1989	74.8	283	557	84.7	27	147
1990	59.9	148	221	88.9	7	59
1991	80.5	95	149	86.7	4	27
1992	79.7	104	410	78.4	46	168
1993	74.5	103	307	87.5	25	176
1994	58.9	304	435	80.8	65	276
1995	72.9	300	806	80.3	85	349
1996	80.6	111	461	88.3	25	188
1997	59.6	545	804	80.3	65	263
1998	64.3	645	1161	76.5	13	42
1999	61.6	843	1353	97.4	9	354
2000	71.4	553	1378	96.7	12	349
2001	90.9	221	2210	80.3	49	202

Hatchery returns

Table 5. Returns of fall Chinook salmon to the trap at Elk River Hatchery by origin and size category. Small fish are less than 55 cm fork length and are predominantly age 2.

Run	Wild		Hatchery	
Year	Large	Small	Large	Small
1970	60	30	0	1336
1971	32	41	650	538
1972	74	69	2199	68
1973	122	162	2991	2378
1974	27	25	619	53
1975	53	53	945	95
1976	18	10	53	233
1977	110	31	2263	486
1978	39	13	512	14
1979	66	5	819	33
1980	23	45	161	105
1981	103	12	251	414
1982	30	17	341	1109
1983	30	3	1172	129
1984	30	0	490	124
1985	10	7	281	1026
1986	14	1	642	505
1987	11	1	830	505
1988	3	0	1137	128
1989	5	0	485	35
1990	4	5	366	54
1991	20	18	233	271
1992	30	14	459	187
1993	46	10	352	116
1994	50	2	550	172
1995	31	3	889	301
1996	35	6	953	161
1997	78	2	1282	292
1998	83	1	1619	63
1999	68	6	1686	304
2000	36	1	1373	338
2001	18	8	3417	448

Spawning Escapement

Table 6. Fall Chinook Spawning Survey Indices and Estimated Escapement in Elk River, 1970-2000. Large Chinook - greater than 55 cm. Expansion factors are from a calibration power function, equations 2.0 and 2.1.

Run	Index		Expansion Factor		Estimate	
Year	Wild	Hatchery	Wild	Hatchery	Wild	Hatchery
1970	567	0	4.22	na	2390	0
1971	122	258	11.85	7.44	1446	1920
1972	168	403	9.56	7.42	1606	2990
1973	151	338	10.27	7.43	1551	2511
1974	144	329	10.60	7.43	1527	2444
1975	80	330	15.75	7.43	1260	2452
1976	94	129	14.13	7.48	1328	965
1977	440	785	5.00	7.38	2200	5795
1978	460	545	4.85	7.40	2232	4034
1979	449	398	4.93	7.42	2214	2953
1980	257	204	7.18	7.46	1845	1521
1981	151	21	10.27	7.58	1551	159
1982	388	139	5.44	7.48	2111	1039
1983	318	558	6.22	7.40	1978	4129
1984	233	751	7.68	7.38	1786	5548
1985	97	264	13.79	7.44	1344	1962
1986	116	306	12.26	7.43	1423	2275
1987	214	829	8.12	7.38	1738	6117
1988	268	582	6.98	7.40	1870	4307
1989	124	466	11.74	7.41	1453	3455
1990	88	250	14.77	7.45	1300	1861
1991	46	154	22.85	7.47	1051	1151
1992	75	136	16.45	7.48	1233	1017
1993	140	145	10.78	7.48	1514	1081
1994	295	92	6.54	7.50	1930	690
1995	314	242	6.28	7.45	1969	1806
1996	136	176	11.02	7.46	1498	1314
1997	79	66	15.88	7.52	1255	496
1998	343	325	5.91	7.43	2028	2415
1999	687	491	3.70	7.41	2545	3637
2000	286	214	6.68	7.45	1911	1595
2001	127	703	11.54	7.39	1465	5194

Comparing the spawning escapement of large fish, generally age 3 and older, two distinct patterns are apparent for fish of different origin. The spawning escapement of large wild origin fish is generally less than of large hatchery origin fish. In several years many more hatchery origin fish escaped to spawn naturally than did wild fish (Figure 2). Most notably in the mid 1970's, and mid- to late 1980's there were large numbers of hatchery origin fish spawning in the river. More recently the numbers of hatchery origin fish are about equal to the wild origin fish on the natural spawning grounds, however in 2001 there was a large increase in the hatchery fish escapement. The natural origin spawners have remained remarkably consistent over the years and average about 1,705 (CV= 22%) large fish, while hatchery origin escapement has averaged about 2,464 (CV=67%).

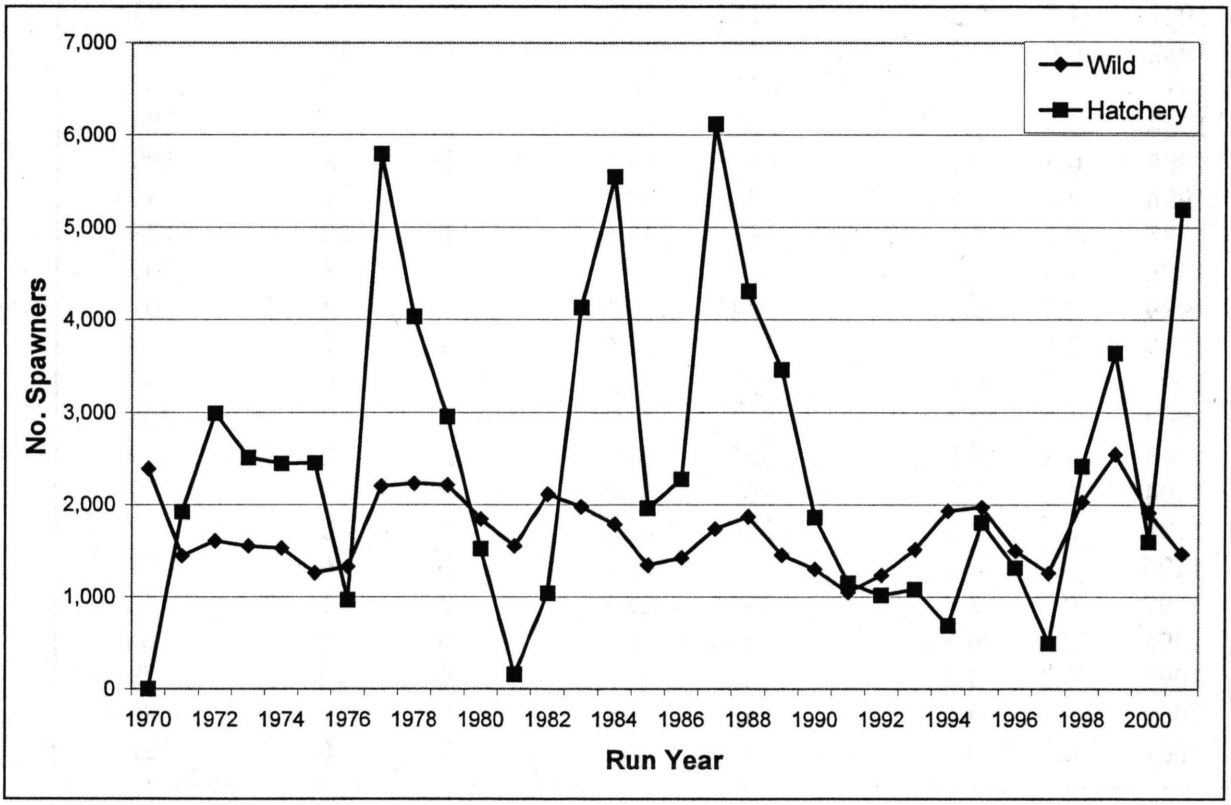

Figure 2. Spawning escapement of wild or hatchery origin large Chinook in the Elk River, Curry County, Oregon, 1970-2001.

Table 7. Fall Chinook spawning survey indices and estimated escapements in Elk River, 1972-2001 for small Chinook - less than 55 cm. The index is the number of small fish observed on the spawning surveys and is not used in the estimate. Estimates prior to 1980 are listed in agency reports without ratios or indices.

Run	Large to Small Ratio		Number Estimated		Survey Index		Exp Factor
Year	Wild	Hatchery	Wild	Hatchery	Wild	Hatchery	Hatchery
1972			3646	1718			
1973			4861	3217			
1974			940	209			
1975			2191	335			
1976			3706	4497			
1977			1334	1836			
1978			550	274			
1979			113	140			
1980	0.4	1.2	4560	1284	28	9	143
1981	4.5	0.2	315	589	0	7	84
1982	6.9	0.2	344	4327	1	47	92
1983	2.8	9.3	657	449	0	7	64
1984	1.9	1.7	860	2802	0	14	200
1985	0.8	0.2	1651	11002	5	58	190
1986	7.6	2.3	135	1295	9	37	35
1987	7.9	3.1	163	2459	1	20	123
1988	8.4	5.1	175	797	2	8	100
1989	8.1	5.3	134	602	1	2	301
1990	12.6	5.2	103	358	0	1	358
1991	4.4	1.9	201	548	5	6	91
1992	2.2	2.4	553	415	0	2	208
1993	4.3	2.3	356	479	2	2	239
1994	5.2	2.2	367	314	9	4	78
1995	3.7	2.6	526	692	5	8	87
1996	4.7	4.1	317	324	2	6	54
1997	9.3	3.8	134	132	2	1	132
1998	52.2	26.5	39	91	0	0	na
1999	59.2	4.6	43	787	0	10	79
2000	45.7	4.0	42	398	0	5	80
2001	4.2	8.7	352	600	3	6	100

For exploitation rate analysis we use the Coded Microwire tagged fish (ERI-stock) as reported on the PSMFC coast wide CWT (RMIS) database. To date only the observed recoveries of Ad+CWT Chinook made on Elk River spawning grounds are listed. The expansion factors listed in Tables 6 and 7 have not been submitted to the RMIS database pending completion of this report. For ERI-stock analysis we need to apply these expansion factors to determine the total number of fish by tag code that were estimated to have escaped to spawn naturally. Appendix A lists the recoveries and the appropriate estimate for each tagged group recovered in the Elk River spawning grounds from 1980 through the 2000 run years. These values will then be used in conjunction with the hatchery census of CWT fish and the estimated harvest rates of hatchery origin fish to estimate the number by tag code of Chinook captured in the fisheries prior to 1992. After 1992 the statistical creel surveys are able to provide annual sample fractions to use as expansion factors on an annual basis.

Table 8. Total return of large fall Chinook salmon to the Elk River by origin, and freshwater harvest rates. Large fish are greater than 55 cm fork length which includes ages 3-7.

Run Year	Number of Wild Fish	Harvest Rate (%)	Number of Hatchery Fish	Harvest Rate (%)
1972	1777	5.5	5481	5.3
1973	1730	3.3	5733	4.0
1974	1873	17.1	4872	37.1
1975	1778	26.2	5377	36.8
1976	1562	13.8	1398	27.2
1977	2760	16.3	9964	19.1
1978	2638	13.9	4917	7.6
1979	3076	25.9	4802	21.5
1980	2015	7.3	1774	5.2
1981	1853	10.8	475	13.5
1982	2462	13.0	1846	25.2
1983	2147	6.5	6164	14.0
1984	2018	10.0	6659	9.3
1985	1482	8.7	2592	13.5
1986	1666	13.8	3371	13.5
1987	2377	26.4	8185	15.1
1988	2406	22.1	6494	16.2
1989	1741	16.2	4497	12.4
1990	1451	10.2	2449	9.0
1991	1166	8.1	1533	9.7
1992	1368	7.6	1886	21.7
1993	1664	6.2	1739	17.6
1994	2284	13.3	1675	26.0
1995	2300	13.0	3501	23.0
1996	1644	6.7	2728	16.9
1997	1878	29.0	2589	31.1
1998	2756	23.4	5195	22.3
1999	3456	24.4	6676	20.3
2000	2500	22.1	4346	31.7
2001	1704	13.0	10821	20.4

Comparison of the total return between wild origin and hatchery origin Chinook to Elk River shows a pattern similar, over the 32 year period, to the spawning ground estimates (Figure 3). The average return of hatchery fish is 4,154 (CV=63%), while the average return of wild fish is 2,090 (CV=29%). The hatchery origin Chinook predominate the run and the natural spawning escapement in the Elk River since the implementation of artificial production in 1968. On the other hand, the return of wild reared fish has remained stable over this period.

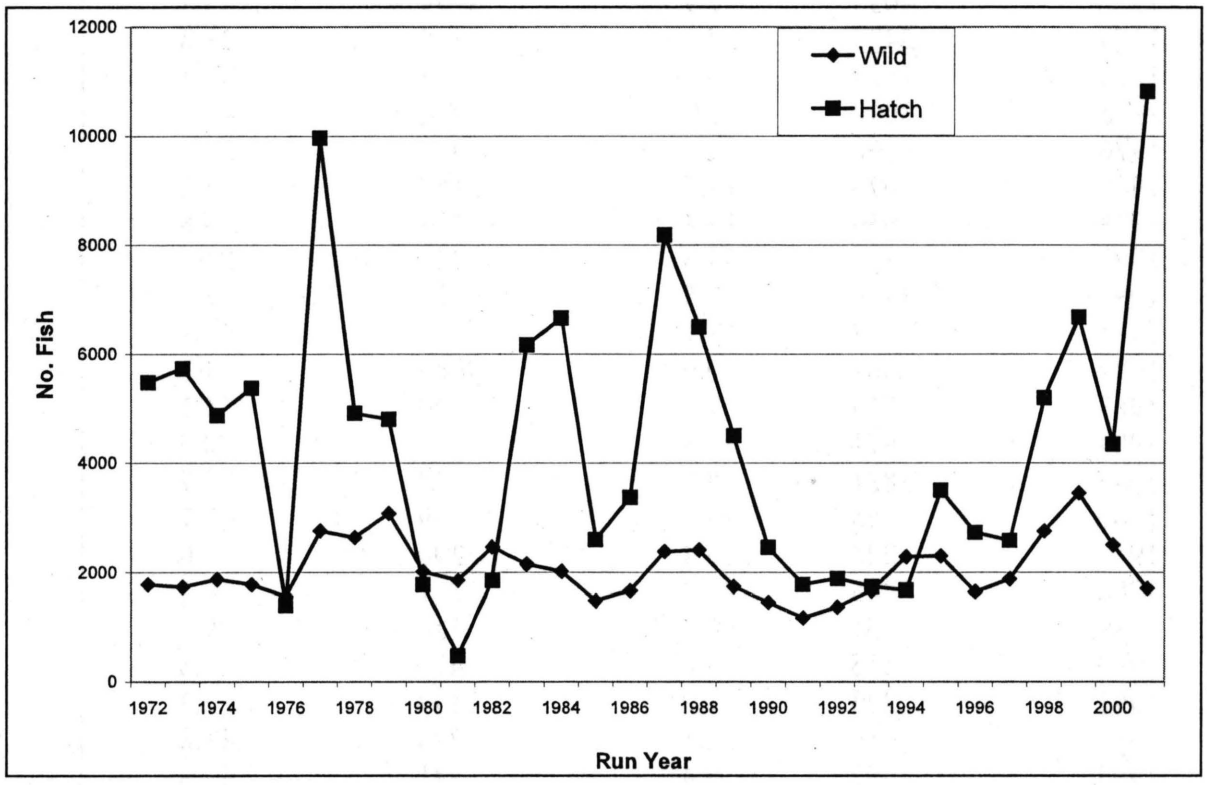

Figure 3. Comparison of the total in-river run of Large (>55cm) Fall Chinook Salmon to the Elk River for hatchery and wild origin fish, 1972-2001.

Because the wild origin fish are not necessarily exclusively from wild parents these trends cannot determine the effects of the hatchery program on the wild gene pool of the native population. However, with a large majority of the spawners being of hatchery origin it is probable that whatever gene pool has been propagated in hatchery fish has been intergraded into the gene pool of natural fish. On the other hand, through careful research studies the

breeding program at that hatchery has been carefully aligned to mimic the characteristics of the naturally producing population.

Table 9. Total return of small fall Chinook salmon to the Elk River by origin, and freshwater harvest rates. Small fish are less than 55 cm fork length which are predominantly age 2 males.

Run Year	Number of Wild Fish	Harvest Rate (%)	Number of Hatchery Fish	Harvest Rate (%)
1972	4035	7.9	3149	43.3
1973	5424	7.4	7345	23.8
1974	1153	16.3	417	37.1
1975	3092	27.4	736	41.5
1976	4360	14.8	6513	27.4
1977	1674	18.5	3157	26.5
1978	650	13.4	334	13.8
1979	158	24.8	228	24.0
1980	4979	7.5	1497	7.2
1981	377	13.1	1755	55.3
1982	401	10.0	7685	44.2
1983	713	7.5	670	24.2
1984	971	11.5	3363	20.9
1985	1821	8.9	14540	27.7
1986	158	13.7	1919	13.7
1987	224	26.4	3290	21.0
1988	225	22.3	1201	36.2
1989	161	16.5	784	29.9
1990	115	6.4	471	12.5
1991	223	1.9	1197	2.3
1992	614	7.5	770	21.8
1993	392	6.4	771	22.8
1994	435	15.0	761	36.2
1995	614	13.9	1342	26.0
1996	348	7.2	673	27.9
1997	201	32.2	687	38.3
1998	53	24.5	196	21.4
1999	58	16.1	1445	24.5
2000	55	21.7	1086	32.2
2001	409	12.1	1249	16.1

Table 10. Total return of hatchery origin fall Chinook salmon to the Elk River and freshwater harvest rates from run reconstruction and from CWT recovery (1992-2001). Includes all sized Chinook. The run reconstruction harvest rates are used to estimate the recoveries of CW-tagged fish in the fishery prior to 1992.

Run	Number of	Harvest Rates (%)	
Year	Chinook	Run Reconstruction	CWT Recovery
1972	8631	19.2	na
1973	13078	15.2	na
1974	5289	37.1	na
1975	6113	37.4	na
1976	7911	27.3	na
1977	13121	20.9	na
1978	5252	7.9	na
1979	5030	21.6	na
1980	3271	6.1	na
1981	2230	36.6	na
1982	9532	28.5	na
1983	6833	14.0	na
1984	10022	10.6	na
1985	17132	16.7	na
1986	5290	10.8	na
1987	11475	13.6	na
1988	7696	17.3	na
1989	5282	13.3	na
1990	2919	9.6	na
1991	2729	6.5	na
1992	2656	21.7	25.4
1993	2510	19.2	27.0
1994	2436	29.2	36.0
1995	4842	23.8	29.9
1996	3401	19.1	9.4
1997	3270	32.6	20.5
1998	5391	22.3	21.8
1999	8121	21.0	26.7
2000	5432	31.8	25.9
2001	12070	20.0	na

Recovery of the ERI-stock

Spawning Ground Recoveries

For every run year the PSMFC data base was queried for the observed recoveries of Elk River ERIS from spawning ground surveys. Because these have not been expanded for the sample fraction the expansion factors from table 6 have been applied to provide the total estimated recoveries by tag code (Table 11).

Hatchery Recoveries

For every run year the PSMFC data base was queried for recoveries of Elk River ERI-stock from hatchery returns. All adipose marked fish returning to the hatchery are sampled for presence of CWT and recorded on the PSMFC database and therefore represent the total return (Table 11).

Fishery Recoveries

For every run year the PSMFC database was queried for all of Elk River ERI-stock recovered in the annual riverine fishery, and the Port Orford troll and sport fishery from the third week in October until the end of the fishing season. The recoveries from 1980-1991 in the database for the riverine fishery list only observed recoveries and have not been expanded for sample fractions (Table 11). After 1991 the PSMFC database lists the estimated catch.

Table 11. Return by run year of Ad+CWT tagged Chinook including the hatchery return and estimated total spawning ground escapement and fishery recoveries.

Run Year	Observed Fishery Recoveries	Total Hatchery Recoveries	Estimated Spawning Ground Recoveries
1981	0	2	137
1982	0	161	242
1983	0	164	947
1984	15	71	561
1985	33	77	601
1986	0	68	181
1987	0	92	417
1988	3	83	178
1989	0	35	222
1990	4	27	112
1991	2	67	151
1992	71	156	52
1993	77	141	67
1994	260	284	176
1995	477	630	489
1996	127	610	620
1997	340	984	338
1998	553	896	1085
1999	714	956	1000
2000	204	218	365

Harvest rates listed in table 10 are used to estimate the total number of Elk River ERI-stock harvested in the riverine fishery by tag code (equation 4.1). The total run to the river is calculated from the harvest rate then the escapement (hatchery returns plus spawning ground estimates) is subtracted to estimate the total fishery recovery of the ERI-stock by equation 4.1 (Table 12).

Table 12. Estimated in-river run of Elk River Exploitation Rate Indicator Stock, apportioned by fishery and escapement components, 1981-2000.

Run Year	Estimated Total Run	Fishery Estimate	Escapement Estimate
1981	220	81	139
1982	563	160	403
1983	1291	180	1111
1984	707	75	632
1985	814	136	678
1986	280	31	249
1987	590	81	509
1988	315	54	261
1989	297	40	257
1990	153	14	139
1991	233	15	218
1992	279	71	208
1993	285	77	208
1994	720	260	460
1995	1596	477	1119
1996	1357	127	1230
1997	1662	340	1322
1998	2534	553	1981
1999	2670	714	1956
2000	787	204	583

The consequent fishery estimated ERI-stock is apportioned by tag code based on the estimated recoveries from the hatchery and spawning ground samples and any fishery samples for the year (Table 13). Prior to 1992 when statistical creel surveys were implemented the observed fishery recoveries were minimal (1981-85) when angler interviews provided the few recoveries. From 1986-89 no interviews were conducted and the estimates were from average harvest from later years (1992-2000). The tag proportions during these years were primarily from the hatchery and estimated spawning ground recoveries. Since 1992 fishery recoveries are estimated annually from data collected during the statistical creel surveys.

Table 13. Estimated recoveries of the ERI-stock Chinook by tag code in the Elk River sportfishery. Estimates are derived from proportion by tag code found in hatchery returns, spawning grounds estimates, and limited fishery sampling.

Run Year	Tag Code	Recoveries from Sampling all strata in the Run	Percent by Tag Code	Estimated Number in the Fishery
1981	071646	39	27.9	23
1981	072008	9	6.2	5
1981	072242	84	60.4	49
1981	071209	8	5.4	4
1982	071646	10	2.6	4
1982	072008	44	10.9	17
1982	072242	24	6.0	10
1982	072243	81	20.1	32
1982	072244	33	8.2	13
1982	072245	33	8.3	13
1982	072535	112	27.8	45
1982	072536	42	10.4	17
1982	072537	18	4.5	7
1982	072538	5	1.2	2
1983	072008	16	1.4	3
1983	072242	158	14.2	26
1983	072243	226	20.4	37
1983	072244	210	18.9	34
1983	072245	130	11.7	21
1983	072535	96	8.6	16
1983	072536	44	3.9	7
1983	072537	16	1.5	3
1983	072538	3	0.3	0
1983	072562	144	13.0	23
1983	072602	68	6.1	11
1984	072242	68	10.6	8
1984	072243	91	14.0	11
1984	072244	33	5.0	4
1984	072245	38	5.9	4
1984	072535	160	24.8	19
1984	072536	108	16.7	13
1984	072537	28	4.3	3
1984	072538	66	10.2	8
1984	072562	35	5.4	4
1984	072602	11	1.8	1
1984	072723	9	1.4	1

Table 13 continued.

Run Year	Tag Code	Recoveries from Sampling all strata in the Run	Percent by Tag Code	Estimated Recoveries in the Fishery
1985	072243	7	1.0%	1
1985	072535	31	4.3%	6
1985	072536	49	6.8%	9
1985	072537	25	3.6%	5
1985	072538	10	1.5%	2
1985	072562	77	10.8%	15
1985	072602	35	4.9%	7
1985	072723	5	0.7%	1
1985	072916	472	66.4%	90
1986	072536	7	3.0%	1
1986	072537	7	3.0%	1
1986	072538	1	0.4%	0
1986	072562	8	3.4%	1
1986	072602	15	6.0%	2
1986	072723	12	5.0%	2
1986	072916	100	40.0%	12
1986	072920	98	39.3%	12
1987	072916	313	61.5%	50
1987	072920	56	11.0%	9
1987	072924	140	27.5%	22
1988	072916	96	36.3%	20
1988	072920	53	20.1%	11
1988	072924	89	33.7%	18
1988	072937	26	9.9%	5
1989	072916	16	6.1%	2
1989	072920	83	32.3%	13
1989	072924	134	51.9%	21
1989	072937	24	9.3%	4
1989	074415	1	0.4%	0
1990	072920	17	11.8%	2
1990	072924	57	40.0%	6
1990	072937	47	33.1%	2
1990	074415	18	12.9%	2
1990	074833	3	2.1%	0
1991	072937	26	12.0%	2
1991	074415	37	16.8%	3
1991	074833	17	7.9%	1
1991	075423	139	63.3%	9

Table 13 continued.

Run Year	Tag Code	Recoveries from Sampling all strata in the Run	Percent by Tag Code	Estimated Recoveries in the Fishery
1992	74415	21	7.5%	3
1992	74833	56	20.2%	9
1992	75423	62	22.2%	22
1992	75663	37	13.2%	12
1992	75701	63	22.6%	16
1992	75702	25	8.9%	6
1992	75703	10	3.6%	3
1992	75704	5	1.8%	0
1993	74009	24	8.4%	0
1993	74010	12	4.2%	0
1993	74833	6	2.1%	4
1993	74948	15	5.3%	2
1993	74951	14	4.9%	5
1993	74953	9	3.2%	5
1993	75423	114	39.9%	30
1993	75663	10	3.5%	5
1993	75701	32	11.2%	5
1993	75702	21	7.5%	5
1993	75703	17	6.0%	9
1993	75704	11	3.9%	7
1994	70422	23	3.2%	15
1994	70423	48	6.7%	29
1994	70424	23	3.2%	12
1994	70425	151	21.0%	44
1994	70426	44	6.1%	24
1994	74009	31	4.3%	12
1994	74010	11	1.5%	9
1994	74948	33	4.5%	15
1994	74951	27	3.7%	6
1994	74953	19	2.6%	12
1994	75423	54	7.4%	12
1994	75663	58	8.1%	9
1994	75701	44	6.1%	13
1994	75702	51	7.0%	15
1994	75703	57	7.9%	12
1994	75704	48	6.6%	21

Table 13 continued.

Run Year	Tag Code	Recoveries from Sampling all strata in the Run	Percent by Tag Code	Estimated Recoveries in the Fishery
1995	70422	54	3.4%	18
1995	70423	198	12.4%	71
1995	70424	70	4.4%	37
1995	70425	109	6.8%	32
1995	70426	74	4.6%	21
1995	70521	203	12.7%	39
1995	70522	63	3.9%	27
1995	70523	1	0.1%	0
1995	70524	47	2.9%	29
1995	70525	27	1.7%	12
1995	74009	54	3.4%	17
1995	74010	41	2.6%	5
1995	74948	65	4.1%	7
1995	74951	133	8.3%	28
1995	74953	159	10.0%	51
1995	75423	6	0.4%	3
1995	75663	27	1.7%	5
1995	75701	40	2.5%	3
1995	75702	72	4.5%	16
1995	75703	44	2.8%	19
1995	75704	106	6.7%	37
1996	70422	107	7.9%	4
1996	70423	181	13.3%	5
1996	70424	47	3.5%	0
1996	70425	73	5.4%	2
1996	70426	102	7.5%	5
1996	70521	59	4.3%	8
1996	70522	108	8.0%	15
1996	70523	114	8.4%	6
1996	70524	112	8.3%	9
1996	70525	114	8.4%	18
1996	70854	154	11.4%	47
1996	74009	26	1.9%	2
1996	74010	20	1.5%	0
1996	74948	50	3.7%	4
1996	74951	45	3.3%	1
1996	74953	38	2.8%	0
1996	75701	1	0.1%	0
1996	75704	4	0.3%	1

Table 13 continued.

Run Year	Tag Code	Recoveries from Sampling all strata in the Run	Percent by Tag Code	Estimated Recoveries in the Fishery
1997	70422	39	2.3%	5
1997	70423	30	1.8%	6
1997	70424	39	2.3%	3
1997	70425	28	1.7%	8
1997	70426	39	2.3%	7
1997	70521	145	8.7%	29
1997	70522	173	10.4%	62
1997	70523	122	7.3%	29
1997	70524	381	22.9%	44
1997	70525	243	14.6%	46
1997	70854	131	7.9%	29
1997	70951	279	16.8%	71
1997	74010	1	0.1%	0
1997	74948	1	0.1%	0
1997	74951	11	0.6%	1
1997	74953	2	0.1%	0
1998	70422	8	0.3%	0
1998	70423	7	0.3%	0
1998	70424	4	0.2%	2
1998	70425	4	0.2%	4
1998	70426	11	0.5%	0
1998	70521	153	6.0%	37
1998	70522	199	7.9%	24
1998	70523	85	3.4%	11
1998	70524	74	2.9%	25
1998	70525	228	9.0%	19
1998	70854	965	38.1%	207
1998	70951	742	29.3%	205
1998	92148	53	2.1%	19
1999	70522	1	0.0%	0
1999	70523	3	0.1%	0
1999	70524	6	0.2%	0
1999	70525	5	0.2%	3
1999	70854	546	20.5%	145
1999	70951	1955	73.2%	521
1999	92148	154	5.8%	45
2000	70854	29	3.7%	11
2000	70951	470	59.7%	104
2000	92148	288	36.6%	89

Table 14. Summary of recovery of Elk River Chinook ERI-stock by tag code and run year in the Port Orford Terminal Fishery from week 42-53, for run years 1981-2001.

Run Year	Tag Code	Estimated PO Catch	Riverine Harvest Rate	Simulated Riverine Catch	Simulated Riverine escapement
1981	71646	6	36.6%	2	4
1981	72008	3	36.6%	1	2
1982	71646	2	28.5%	1	1
1982	72008	6	28.5%	2	4
1982	72242	5	28.5%	1	4
1982	72243	24	28.5%	7	17
1982	72244	8	28.5%	2	6
1982	72245	5	28.5%	1	4
1983	72242	10	14.0%	1	9
1983	72243	20	14.0%	3	17
1983	72244	21	14.0%	3	18
1983	72245	22	14.0%	3	19
1983	72535	20	14.0%	3	17
1983	72536	18	14.0%	3	15
1983	72537	3	14.0%	0	3
1984	72242	4	10.6%	0	4
1984	72243	8	10.6%	1	7
1984	72244	1	10.6%	0	1
1984	72245	3	10.6%	0	3
1984	72535	16	10.6%	2	14
1984	72536	17	10.6%	2	15
1984	72537	7	10.6%	1	6
1984	72538	10	10.6%	1	9
1984	72562	21	10.6%	2	19
1984	72602	5	10.6%	1	4
1985	72243	2	16.7%	0	2
1985	72244	1	16.7%	0	1
1985	72535	11	16.7%	2	9
1985	72536	9	16.7%	2	7
1985	72537	2	16.7%	0	2
1985	72538	3	16.7%	1	2
1985	72562	20	16.7%	3	17
1985	72602	5	16.7%	1	4
1985	72723	2	16.7%	0	2
1986	72536	2	10.8%	0	2
1986	72562	1	10.8%	0	1
1986	72723	1	10.8%	0	1
1986	72916	46	10.8%	5	41

Table 14. Continued

Run Year	Tag Code	Estimated PO Catch	Riverine Harvest Rate	Simulated Riverine Catch	Simulated Riverine escapement
1987	72916	83	13.6%	11	72
1987	72920	5	13.6%	1	4
1989	72916	4	13.3%	1	3
1989	72920	24	13.3%	3	21
1989	72924	96	13.3%	13	83
1989	72937	7	13.3%	1	6
1990	72920	3	9.6%	0	3
1990	72924	5	9.6%	0	5
1990	72937	5	9.6%	0	5
1990	74415	1	9.6%	0	1
1992	74833	2	25.4%	1	1
1992	75423	3	25.4%	1	2
1993	75423	44	27.0%	12	32
1994	74009	7	36.0%	3	4
1994	74010	7	36.0%	3	4
1994	74948	5	36.0%	2	3
1994	74951	7	36.0%	3	4
1994	74953	14	36.0%	5	9
1994	75423	9	36.0%	3	6
1995	70422	12	29.9%	4	8
1995	70423	26	29.9%	8	18
1995	70424	12	29.9%	4	8
1995	70425	23	29.9%	7	16
1995	70426	26	29.9%	8	18
1995	74009	18	29.9%	5	13
1995	74010	12	29.9%	4	8
1995	74948	8	29.9%	2	6
1995	74951	12	29.9%	4	8
1995	74953	11	29.9%	3	8
1996	70422	46	9.4%	4	42
1996	70423	80	9.4%	7	73
1996	70424	20	9.4%	2	18
1996	70425	38	9.4%	4	34
1996	70426	45	9.4%	4	41
1996	70521	47	9.4%	4	43
1996	70522	72	9.4%	7	65
1996	70523	63	9.4%	6	57
1996	70524	59	9.4%	6	53
1996	70525	94	9.4%	9	85

Table 14. continued.

Run Year	Tag Code	Estimated PO Catch	Riverine Harvest Rate	Simulated Riverine Catch	Simulated Riverine escapement
1996	74009	6	9.4%	1	5
1996	74010	3	9.4%	0	3
1996	74948	12	9.4%	1	11
1996	74951	21	9.4%	2	19
1996	74953	10	9.4%	1	9
1997	70422	12	20.5%	2	10
1997	70423	9	20.5%	2	7
1997	70424	4	20.5%	1	3
1997	70425	10	20.5%	2	8
1997	70426	12	20.5%	2	10
1997	70521	42	20.5%	9	33
1997	70522	56	20.5%	11	45
1997	70523	38	20.5%	8	30
1997	70524	61	20.5%	12	49
1997	70525	53	20.5%	11	42
1997	70854	37	20.5%	8	29
1997	74951	1	20.5%	0	1
1998	70425	4	21.8%	1	3
1998	70521	36	21.8%	8	28
1998	70522	4	21.8%	1	3
1998	70523	10	21.8%	2	8
1998	70524	24	21.8%	5	19
1998	70525	27	21.8%	6	21
1998	70854	197	21.8%	43	154
1998	70951	146	21.8%	32	114
1999	70522	4	26.7%	1	3
1999	70854	111	26.7%	30	81
1999	70951	504	26.7%	135	369
1999	92148	40	26.7%	11	29
2000	70854	17	25.9%	4	13
2000	70951	137	25.9%	36	101
2000	92148	82	25.9%	21	61

Table 15. Simulated in-river return of Elk River Chinook ERI-stock incorporating the terminal Port Orford fishery in the return, 1981-2000.

Run Year	Tag Code	Simulated	
		Harvest	Escapement
1981	71646	25	43
1981	72008	6	11
1981	72242	50	85
1981	71209	6	12
1982	71646	5	14
1982	72008	24	61
1982	72242	12	30
1982	72243	33	85
1982	72244	14	42
1982	72245	16	50
1982	72535	48	130
1982	72536	20	61
1982	72537	10	35
1982	72538	5	20
1983	72008	3	19
1983	72242	26	162
1983	72243	38	233
1983	72244	34	211
1983	72245	21	133
1983	72535	18	110
1983	72536	9	59
1983	72537	4	22
1983	72538	1	12
1983	72562	25	163
1983	72602	12	72
1984	72242	8	69
1984	72243	11	92
1984	72244	6	42
1984	72245	6	45
1984	72535	19	159
1984	72536	14	109
1984	72537	6	45
1984	72538	9	69
1984	72562	4	32
1984	72602	1	12
1984	72723	1	7

Table 15. continued

Run Year	Tag Code	Simulated	
		Harvest	Escapement
1985	72243	1	8
1985	72535	11	72
1985	72536	20	121
1985	72537	6	28
1985	72538	3	13
1985	72562	18	97
1985	72602	20	116
1985	72723	2	9
1985	72916	90	448
1986	72536	1	12
1986	72537	1	12
1986	72538	0	2
1986	72562	2	9
1986	72602	3	17
1986	72723	14	44
1986	72916	15	104
1986	72920	15	102
1987	72916	52	316
1987	72920	12	60
1987	72924	27	149
1988	72916	23	102
1988	72920	15	61
1988	72924	26	105
1988	72937	9	33
1989	72916	9	32
1989	72920	21	101
1989	72924	26	147
1989	72937	8	32
1989	74415	2	7
1990	72920	6	25
1990	72924	9	65
1990	72937	6	88
1990	74415	9	90
1990	74833	2	19
1991	72937	6	59
1991	74415	7	78
1991	74833	5	59
1991	75423	16	204

Table 15. continued

Run Year	Tag Code	Simulated	
		Harvest	Escapement
1992	74415	9	75
1992	74833	15	100
1992	75423	31	125
1992	75663	13	30
1992	75701	16	50
1992	75702	7	30
1992	75703	5	26
1992	75704	1	14
1993	74009	2	34
1993	74010	2	19
1993	74833	5	5
1993	74948	4	21
1993	74951	7	19
1993	74953	14	37
1993	75423	41	129
1993	75663	13	35
1993	75701	17	76
1993	75702	16	58
1993	75703	17	37
1993	75704	7	5
1994	70422	16	11
1994	70423	37	47
1994	70424	13	14
1994	70425	46	115
1994	70426	29	39
1994	74009	18	40
1994	74010	52	156
1994	74948	47	132
1994	74951	7	24
1994	74953	42	88
1994	75423	147	411
1994	75663	20	78
1994	75701	17	44
1994	75702	51	137
1994	75703	33	106
1994	75704	25	38

Table 15. continued

Run Year	Tag Code	Simulated	
		Harvest	Escapement
1995	70422	18	36
1995	70423	71	127
1995	70424	37	33
1995	70425	32	77
1995	70426	21	53
1995	70521	39	164
1995	70522	27	36
1995	70523	0	1
1995	70524	29	18
1995	70525	12	15
1995	74009	17	37
1995	74010	5	36
1995	74948	7	58
1995	74951	28	105
1995	74953	51	108
1995	75423	3	3
1995	75663	5	22
1995	75701	3	37
1995	75702	16	56
1995	75703	19	25
1995	75704	37	69
1996	70422	4	103
1996	70423	5	176
1996	70424	0	47
1996	70425	2	71
1996	70426	5	97
1996	70521	8	51
1996	70522	15	93
1996	70523	6	108
1996	70524	9	103
1996	70525	18	96
1996	70854	47	107
1996	74009	2	24
1996	74010	0	20
1996	74948	4	46
1996	74951	1	44
1996	74953	0	38
1996	75701	0	1
1996	75704	1	3

Table 15. continued.

Run Year	Tag Code	Simulated	
		Harvest	Escapement
1997	70422	5	34
1997	70423	6	24
1997	70424	3	36
1997	70425	8	20
1997	70426	7	32
1997	70521	29	116
1997	70522	62	111
1997	70523	29	93
1997	70524	44	337
1997	70525	46	197
1997	70854	29	102
1997	70951	71	208
1997	74010	0	1
1997	74948	0	1
1997	74951	1	10
1997	74953	0	2
1998	70422	0	8
1998	70423	0	7
1998	70424	2	2
1998	70425	4	0
1998	70426	0	11
1998	70521	37	116
1998	70522	24	175
1998	70523	11	74
1998	70524	25	49
1998	70525	19	209
1998	70854	207	758
1998	70951	205	537
1998	92148	19	34
1999	70522	0	1
1999	70523	0	3
1999	70524	0	6
1999	70525	3	2
1999	70854	145	401
1999	70951	521	1434
1999	92148	45	109
2000	70854	11	18
2000	70951	104	366
2000	92148	89	199

Discussion

This report collates, summarizes, and uses a long series of monitoring data from the Elk River population of Fall Chinook Salmon for run reconstruction and preparation for exploitation rate analysis. Monitoring of this stock has taken place over the last 33 years. This is one of the longest datasets for any coastal stock of salmon in Oregon. Earlier research and monitoring was motivated by the need to design operations of a new hatchery to optimize production of the domestic stock while maintaining the biological integrity and productivity of the native population. As hatchery operations conformed to this ideal research efforts were diminished, however, a long term monitoring program was maintained. As a result of this change in emphasis, some aspects of the sampling were reduced, especially the intensive fishery sampling. Initially, statistical creel surveys provided sound estimates of Chinook harvest in the river, as staff was reduced, these surveys were dropped. The mark-recapture experiments were no longer carried out and a run size estimation procedure was developed that relied on relationships between spawner indices and run size as shown by the research studies. In the early 1990's intensive sampling efforts were renewed. In order to make this stock an exploitation rate indicator the harvest estimations were again based on a statistical design.

These changes resulted in different estimators being used to estimate the run size over the years. The run size statistics were constructed by means of various relationships of indices and run size as revealed by either the research studies or by averages during years when these values were not measured. To prepare the stock for integration to the Chinook Technical Committee Exploitation Rate Analysis, the terminal troll fishery in the immediate area of the Elk River needed to be excluded from the ocean exploitation estimate. This is necessary because the natural stocks for which the Elk River domestic stock serves as an indicator do not undergo the same terminal ocean fishery harvest. This paper developed methods to accomplish this compensation by simulating the catch in the terminal fishery into the escapement to the river. To do this it was necessary to use the riverine harvest rate as a common denominator for estimating the catch during years when no creel surveys were conducted. Because the riverine harvest rates could only be estimated from the run reconstruction these were made for each year beginning in 1972. Although the exploitation rate analysis can only be made with the run

beginning in 1981, the earlier information will be useful to local managers in monitoring the success of the domestic stock and the productivity of the native stock.

For many years the reconstructed run served as the only basis for estimating the riverine harvest rate, however since 1992 we can also use the recovery of only Coded-microwire tagged fish and calculate the harvest rate of these marked fish. We should expect the harvest rates would be similar using either the run reconstruction or the recovery of CW-tagged fish. Unfortunately, this is not the case. We see that there is both a bias and lack of correlation between these two sources of harvest rate (Figure 4), although the estimates are within a similar range of values (Table 16).

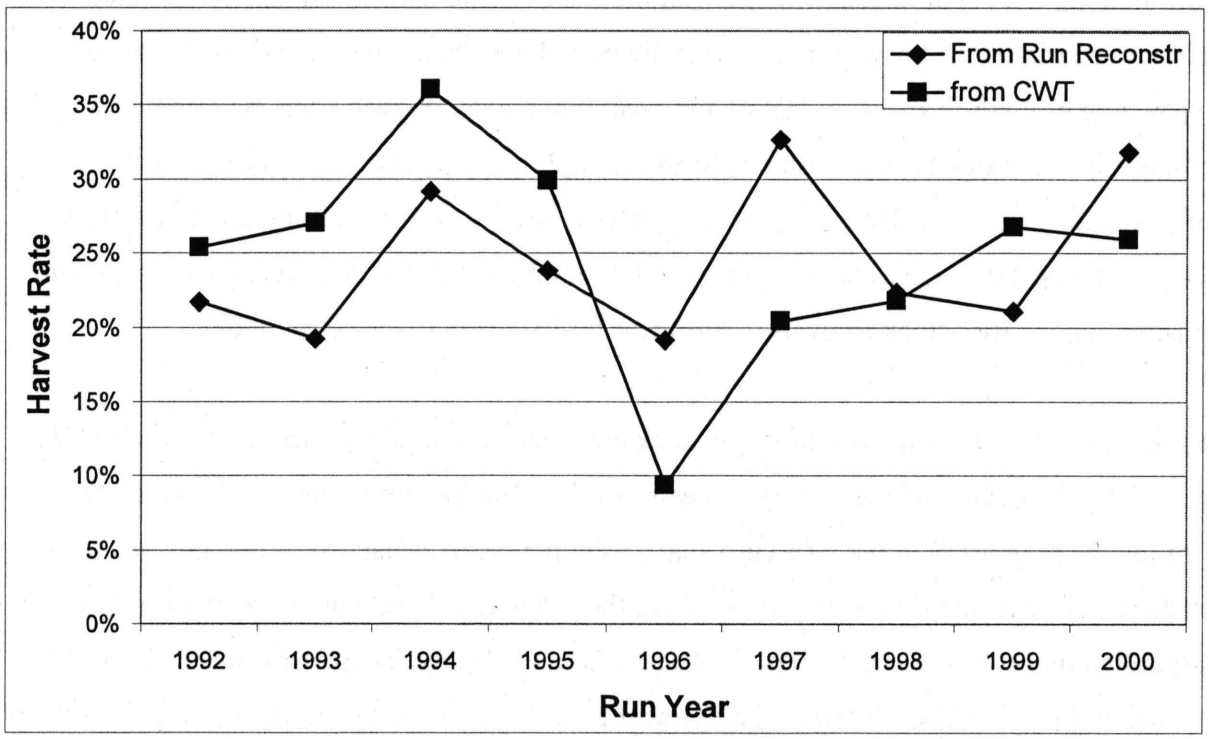

Figure 4. Comparison of the harvest rates of Fall Chinook Salmon in the Elk River sport fishery as estimated by run reconstruction or recovery of ERI-stock (Ad+CWT).

Table 16. Comparison of the riverine harvest rates of Elk River Chinook Salmon by run reconstruction or recovery of CW-tagged fish. Samples from the period 1992-2000.

	---------- Harvest Rates from: ----------	
Statistic	Run Reconstruction	CWT based
Averages	24.1%	24.7%
StDev	5.3%	7.3%
CV	22%	30%

At present, the reasons for the differences have not been investigated. Because the run reconstruction includes wild and hatchery fish, some marked and unmarked, while the marked fish are a small subset of the run reconstruction, the variances in the two estimators may cause the differences. On the other hand, similar sample fractions are used to expand the sampled number to the estimates. Some problems may lie with the estimates of small fish <55 cm. on the spawning grounds, Expansion factors for small fish are not derived from the sample fractions but from large to small fish ratios from sampling the hatchery and fishery. In the future this incompatibility needs to be investigated. However, for the present, these values on average, are essentially the same and gives reason to believe that the current analysis of the run reconstruction for ERI-stock analysis is sufficient for inclusion in the coast model.

The Elk River Exploitation Rate Indicator stock are hatchery reared fish that have an Ad+CWT mark and can be linked throughout their ocean and river life cycle by means of this mark to determine the proportion of the year class that was either taken as harvest or that escaped to reproduce. This statistic is used in part, to judge the adequacy of the management measures incorporated in the 1999 agreement of the Pacific Salmon Treaty. These same measures are also used in the US offshore fishery management process as conducted under the auspices of the Pacific Fisheries Management Council. By adopting the Elk River stock as an ERI-stock Oregon can be assured that those naturally producing populations of Chinook in the Umpqua and mid-south gene conservation groups can be appropriately represented in the harvest management regimes of the ocean fisheries.

To maintain the continuity of these processes, provisions within the agency must be made to continue a consistent monitoring program annually on this stock. This necessitates the

sampling of the following strata: 1) the Port Orford terminal ocean fishery; 2) the riverine sport fishery; 3) hatchery returns; and 4) spawning grounds. At present these strata are being sampled through arrangements with the US Section of the Pacific Salmon Commission.

Run reconstruction can serve several purposes. Agency managers can use this information to: 1) formulate expectations for the production of domestic stock while sustaining the native population; 2) formulate management plans for the Elk River; and 3) establish harvest guidelines for the riverine fisheries. Because a number of natural production studies have been made the adult run size can serve as the final production statistic for exploring various land use management practices in the basin. Agency managers can now measure the impact of harvest on this stock and the Mid-south GCG through status of the exploitation rate on the ERI-stock. The Coastal Chinook Management Plan (1992) calls for a maximum 67.5% harvest rate on the fully vulnerable age-4 cohort as a goal for mid-maturing coastal stocks. By using the Elk River ERI-stock the agency can for the first time monitor the compliance with its Coastal Chinook Management Plan.

These data are valuable for management of Ocean Fisheries in the NE Pacific through the PSC, or PFMC. The exploitation rates derived from incorporating this ERI-stock in their analysis will yield statistics that can be used by ODFW to construct a stock-recruitment analysis for the Coquille wild stock of Chinook salmon. This stock is proposed by the agency to use as an escapement indicator stock for the Mid-South Gene Conservation group. Escapement indicator stocks are used to measure the ultimate impact of ocean harvest regimes. At present the ODFW has implemented Escapement Indicator stocks for 3 populations in the N-E and Mid-North GCG's. Addition of at least one Escapement Indicator stock in the Mid-South GCG will complement monitoring the impacts of ocean fisheries on this group. Additionally, the Pacific Salmon treaty will be re-negotiated in 2007 and the ODFW can add the Mid-South GCG, with its Escapement Indicator Stock (Coquille) and Exploitation rate indicator stock (Elk River) to the chapter 3, section 9 provisions of the treaty. This section deals with weak stock management measure by specifying trigger mechanisms for reducing harvest based on status of escapement indicator stocks. Addition of this GCG will assure that status of this group will be considered in harvest management plans in the PSC.

Recommendations

A) The current level of sampling needs to continue to maintain the ERI-stock monitoring protocol to CTC standards and to build a reliable database for this ERI-stock.

B) It is recommended that research be conducted to re-calibrate the procedure for estimating the spawning escapement. The last calibration studies were conducted in 1972-80 and failed to adequately address estimating the escapement of small <55 cm Chinook.

C) The agency should now proceed with the stock – recruitment analysis of the Coquille natural stock, using the exploitation rate from the Elk River ERI-stock The agency can then adopt spawning escapement goals for the Coquille natural stock as per the 1999 agreement of the Pacific Salmon Treaty.

D) The agency should prepare for the incorporation of the Mid-south Gene Conservation group in the Chapter 3, section 9 provision of the Pacific Salmon Treaty when it is re-negotiated in 2007. By completing the Coquille Escapement Indicator stock analysis and establishing an escapement goal for that stock, and inclusion of the Elk River ERI-stock in the CTC analysis, the Mid-south GCG can be included in the Pacific Salmon Treaty Chinook management program.

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Appendix A. Recovery of AD+CWT Chinook salmon on Elk River Spawning Ground Surveys, 198-2000. Listed are the annually observed and estimated recoveries by tag code.

Run Year	Tag Code	Observed	Estimate
1981	71646	5	38
1981	72008	1	8
1981	72242	1	84
1981	71209	1	8
1982	71646	1	7
1982	72008	4	30
1982	72242	2	15
1982	72243	8	60
1982	72244	2	15
1982	72245	3	22
1982	72535	1	92
1983	72008	2	15
1983	72242	20	148
1983	72243	28	207
1983	72244	23	170
1983	72245	14	104
1983	72535	10	74
1983	72536	4	30
1983	72537	1	7
1983	72562	2	128
1983	72602	1	64
1984	72242	9	66
1984	72243	12	89
1984	72244	4	30
1984	72245	5	37
1984	72535	19	140
1984	72536	13	96
1984	72537	3	22
1984	72538	8	59
1984	72562	2	15
1984	72602	1	7

Appendix A continued.

Run Year	Tag Code	Observed	Estimate
1985	72243	1	7
1985	72535	4	30
1985	72536	6	45
1985	72537	3	22
1985	72538	1	7
1985	72562	8	60
1985	72602	4	30
1985	72916	4	400
1986	72536	1	7
1986	72537	1	7
1986	72562	1	7
1986	72602	2	15
1986	72723	1	7
1986	72916	9	67
1986	72920	2	70
1987	72916	38	280
1987	72920	5	37
1987	72924	1	100
1988	72916	12	89
1988	72920	5	37
1988	72924	7	52
1989	72916	2	15
1989	72920	10	74
1989	72924	16	119
1989	72937	2	15
1990	72920	2	15
1990	72924	7	52
1990	72937	5	37
1990	74415	1	7
1991	72937	3	22
1991	74415	4	30
1991	74833	1	7
1991	75423	1	91
1992	74415	2	15
1992	74833	5	37
1993	75423	6	45
1993	75701	2	15
1993	75702	1	7

Appendix A continued.

Run Year	Tag Code	Observed	Estimate
1994	70425	1	78
1994	74948	1	8
1994	74951	1	8
1994	75423	3	23
1994	75663	4	30
1994	75702	1	8
1994	75703	2	15
1994	75704	1	8
1995	70422	1	7
1995	70423	10	74
1995	70424	1	7
1995	70425	5	37
1995	70426	2	15
1995	70521	1	87
1995	74009	1	7
1995	74010	3	22
1995	74948	4	30
1995	74951	5	37
1995	74953	7	52
1995	75663	1	7
1995	75701	2	15
1995	75702	5	37
1995	75703	2	15
1995	75704	5	37
1996	70422	10	75
1996	70423	15	112
1996	70424	3	22
1996	70425	3	22
1996	70426	9	67
1996	70521	2	15
1996	70522	7	52
1996	70523	6	45
1996	70524	7	52
1996	70525	5	37
1996	74009	2	15
1996	74010	2	15
1996	74948	5	37
1996	74951	4	30
1996	74953	3	22

Appendix A continued.

Run Year	Tag Code	Observed	Estimate
1997	70422	1	8
1997	70424	2	15
1997	70426	1	8
1997	70521	4	30
1997	70522	2	15
1997	70523	4	30
1997	70524	23	173
1997	70525	5	38
1997	70854	2	15
1997	70951	1	8
1998	70422	1	7
1998	70423	1	7
1998	70426	1	7
1998	70521	11	82
1998	70522	19	141
1998	70523	7	52
1998	70524	1	7
1998	70525	20	149
1998	70854	60	446
1998	70951	25	186
1999	70854	25	185
1999	70951	103	763
1999	92148	7	52
2000	70854	1	7
2000	70951	33	246
2000	92148	15	112

Appendix B. Observed recoveries in the riverine sportfishery from historical records in Elk River. These samples provide the basis to determine the proportion of the Chinook catch by hatchery or wild origin and by large (>55cm) or small fish (<55cm).

	Large Chinook (>55cm)			Small Chinook (<55cm)		
Run Year	No. Wild	No. Hatchery	No. Unknown	No. Wild	No. Hatchery	No. Unknown
1972	14	42	1	43	183	24
1973	10	40	2	53	231	20
1974	50	283	41	28	23	9
1975	71	302	72	114	41	30
1976	41	72	48	87	241	168
1977	56	237	147	27	73	69
1978	77	78	22	17	9	5
1979	85	110	0	5	7	0
1980	16	10	11	38	11	4
1981	31	10	30	9	137	70
1982	71	103	80	8	448	283
1983	47	291	0	18	31	0
1984	24	74	1	13	51	2
1985	25	68	1	32	494	0
1986	na	na	na	na	na	na
1987	na	na	na	na	na	na
1988	na	na	na	na	na	na
1989	na	na	na	na	na	na
1990	18	27	19	1	8	4
1991	21	87	9	2	13	0
1992	27	106	9	8	29	1
1993	72	214	2	1	7	0
1994	174	249	8	32	135	8
1995	157	375	0	36	147	0
1996	35	149	5	9	68	0
1997	378	546	0	43	175	0
1998	188	386	0	4	13	0
1999	241	431	0	3	113	0
2000	139	347	5	3	88	0
2001	47	481	0	12	49	0