

**PACIFIC SALMON COMMISSION  
JOINT CHUM TECHNICAL COMMITTEE  
FINAL 1994 - 2001 POST SEASON SUMMARY REPORT  
TCCHUM (03)-1**

**April, 2003**

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## **1. INTRODUCTION**

This Joint Chum Salmon Technical Committee report presents the appropriate information on chum salmon stocks and fisheries in southern British Columbia and Washington for the years 1994 through 2001. It also addresses the specific provisions and requirements of Chapter 6 of Annex IV of the Pacific Salmon Treaty (PST) (Attachment 1).

The treaty between the governments of Canada and the United States of America (U.S.) concerning Pacific salmon was designed to facilitate co-operation between the two countries in the management, research and enhancement of Pacific salmon stocks. Chapter 6 of Annex IV of the Pacific Salmon Treaty (PST) required that certain fisheries for chum salmon in southern British Columbia (B.C.) and Washington be managed in a specified manner. Other fisheries, while not specifically mentioned in the PST, are known to harvest chum of the other country's origin. This report discusses various aspects of the chum present in Washington State and in B.C. waters between Vancouver Island and the mainland and off the west coast of Vancouver Island, and discusses the management actions of Canada and the U.S. in relation to the PST requirements.

The Chum Annex (Chapter 6 of Annex IV of the PST) had been renewed for one or more years since it was initially negotiated in 1987. However, in 1994, the Parties to the PST were unable to reach agreement on a number of provisions of the PST, including the Chum Annex. Thus, no formal agreement existed for the 1994 season, although the parties essentially continued to observe the provisions of the expired annex.

In 1995 the Parties were able to agree on a Chum Annex that was essentially the same as had existed in the years immediately prior to 1994. This annex was renewed annually until 1999 when a new Chum Annex was negotiated for a term of 10 years (Attachment 1). This new annex was updated to be consistent with changes in the "Clockwork" management strategy implemented by Canada for fisheries in Johnstone Strait. It also included provisions to address the conservation concerns the United States has for Hood Canal and Strait of Juan de Fuca summer chum, which have been listed as a "threatened" species under the United States' Endangered Species Act.

## **2. STATUS OF TREATY REQUIREMENTS**

Chum stocks and fisheries in southern British Columbia and in United States Areas 4B, 5, 6C, 7, 7A (Attachments 2) are managed under the terms set out in the Pacific Salmon Treaty. The following provides a brief synopsis of the provisions of the Chum Annex (*italics*) and of Canadian and U.S. management actions to meet those provisions in the years 1994 through 2001. New Chum Annex provisions included in the 1999 revised version are noted as such.

### **2.1 Paragraph 1:**

*The Parties were to maintain a Joint Chum Technical Committee(Technical Committee) to review stock status, develop new methods for stock management and report on management and research findings.*

The Technical Committee has convened at least annually over the period from 1994 though 2001 to exchange preliminary results from each years' fishery and other information regarding chum salmon management. The Committee completed post-season reports for the 1992 and 1993 seasons during that time period, but did not complete post-season reports for any other years. The Committee did not undertake, nor complete any other reports on management or research findings. Work on many of the Technical Committee's tasks has been hampered by a small number of committee members with limited available time, and by a dearth of data from the Parties, because of budget reductions in both the U.S. and Canada.

### **2.2 Paragraph 2:**

*Canada was to manage its inside fisheries to provide rebuilding of depressed naturally spawning stocks and minimize increased interceptions of U.S. chum.*

Table 4 provides an evaluation of the performance of the Clockwork management strategy. The total estimated wild escapement in the Clockwork management area met or exceeded the goal of 2.5 million in 4 out of 8 years from 1994 through 2001. This is a significant improvement over the previous 8 years when escapement goals were not achieved in any year. While the technical committee has not specifically evaluated stock compositions or the issue of "minimizing interceptions", the catch levels in the Clockwork fisheries indicated a declining level of harvest over the period from 1994 through 2001, and likely represent declining interceptions of U.S. chum salmon in these fisheries.

### **2.3 Paragraph 3:**

*Canada was to manage its Johnstone Strait Clockwork harvest to set exploitation rates dependent on the run size entering Johnstone Strait, as determined in-season. The catch level of chum salmon in U.S. fishing Areas 7 and 7A was determined by the catch of chum salmon in Johnstone Strait. In addition, the total proportion of effort and catch between Areas 7 and 7A was to be maintained.*

Canada has managed its fishery in Johnstone Strait consistent with the Clockwork harvest levels during the 1994 to 2001 time period. Results are provided in Table 4. Canada made a change in one of the exploitation rate breakpoints in 1992 that was not reflected in the annex language until 1999. The U.S. fishery in Areas 7 and 7A was managed consistent with the catch triggers provided for in the annex, and consistently caught fewer chum salmon than allowed by the annex quotas (see table 15). The proportion of catch between Areas 7 and 7A is shown in Table 14, and is generally consistent with the historical distribution.

#### **2.4 Paragraph 4:**

*The U.S. was to maintain the limited effort nature of its chum fishery in U.S. Areas 4B, 5, and 6C to minimize increased interceptions of Canadian chum. In addition the U.S. was to monitor this fishery for increasing interceptions of Canadian chum.*

This fishery has continued to be restricted to gillnet gear only and to treaty Indian fishermen from four tribes. The technical committee has not specifically addressed interception estimates during the 1994 through 2001 time period, or the issue of “minimizing increased interceptions”. However, GSI samples collected from the fishery indicate the great majority of the catch is chum salmon of U.S. origin, and the total catch in the fishery has declined significantly over the period from 1994 through 2001 (see Table 12). It is likely that interceptions have decreased as well.

#### **2.5 Paragraph 5:**

*When the catch of chum salmon in U.S. Areas 7 and 7A fails to achieve the specified ceiling, the ceiling in subsequent years will be adjusted accordingly.*

The U.S. Fishery in Areas 7 and 7A fell short of its catch ceiling in both years that a significant fishery occurred (1995 and 1998), and an adjustment is called for under the terms of the annex. The cumulative shortfall due the U.S. is 174,256 chum salmon (See Table 15).

#### **2.6 Paragraph 6:**

*Catch composition in fisheries covered by this chapter was to be estimated post-season using methods agreed upon by the Joint Chum Technical Committee.*

Fisheries covered by this chapter were sampled for stock composition in some years (See Tables 16 and 17), and stock composition estimates are available. However, the Joint Chum Technical Committee has not specifically reviewed and reported on these results for the 1994 to 2001 period. Catch compositions have recently received low funding priorities due to budget constraints.

#### **2.7 Paragraph 7:**

*Canada was to manage the Nitinat chum fishery to minimize the harvest of non-targeted stocks.*

During the 1994 to 2001 period the catch levels in this fishery have been highly variable. The technical Committee has not specifically addressed the issue of “minimizing the harvest of non-target stocks”. Canada has addressed specific by-catch concerns by delayed opening dates, continued use of reduced fishing area, increased use of weed lines, and selective fishing techniques.

## **2.7 Paragraph 8:**

*Canada was to conduct genetic stock identification (GSI) sampling of the West Coast Vancouver Island troll fishery (Areas 121-124) if catch levels were predicted to reach levels similar to those in 1985 and 1986.*

The West Coast Vancouver Island troll fishery catch of chum salmon has been specifically constrained during the period 1994 – 2001 for domestic allocation purposes and the catch levels have been well below those experienced in 1985. Therefore no GSI sampling was necessary and none has occurred.

## **2.9 Paragraph 9 (added in 1999):**

*From August 1 to September 15 of each year, purse seine fisheries in Canadian Area 20 and non-Indian seine fisheries in U.S. Areas 7 and 7A shall release all chum salmon.*

Regulations have been implemented by both countries to require the live release of chum salmon in these areas.

## **2.10 Paragraph 10 (added in 1999):**

*The parties will assess chum catches and attempt to collect GSI samples from boundary area fisheries during the August 1 to September 15 time period.*

Tables 5 and 13 provide the catch of chum salmon during the period of summer chum migration in boundary areas. Due to the low numbers of chum encountered during this time period, neither the U.S. nor Canada have collected any GSI samples.

# **3. CANADIAN INSIDE CHUM**

## **3.1 Introduction**

Southern B.C. chum salmon stocks and fishing areas are, for the purposes of management, analysis and reporting, divided into two major components. The stocks of Johnstone and Georgia straits, herein termed Inside chum, and those of the West Coast of Vancouver Island (WCVI), including Juan de Fuca Strait, termed West Coast chum. The primary fisheries of concern for these years are the WCVI Nitinat Lake, Johnstone, Georgia and Juan de Fuca straits and the Fraser River.

## **3.2 Status of Treaty Requirements**

A bilateral agreement for sharing of chum salmon was reached on July 2, 1998. Canada and the U.S. agreed to implement, without any prejudice to future agreements, the most recently expired sharing arrangement as outlined in Chapter 6 of Annex IV of the Pacific Salmon Treaty. Canada would continue to manage chum fisheries in Johnstone Strait, Strait of Georgia and Fraser River areas in a manner consistent with the Clockwork plan and minimize, where practicable, interceptions of United States origin stocks. The U.S.

would limit its harvest of Canadian chum in some areas to negotiated catch ceilings as specified in the essential sharing arrangements of Chapter 6.

### **3.3 Conservation and Harvest Management Requirements**

Inside chum are managed with the long term objective of providing maximum benefits to the fishing industry. The general approach adopted by the Department of Fisheries and Oceans (DFO) is to achieve the present target wild escapements, while augmenting production through enhancement of selected stocks. In practice, this approach is achieved through the application, in mixed stock fishery areas, of harvest rates which are compatible with wild or natural stock productivity. If there are stocks which return to their area of origin in numbers above that area's escapement goal, they may be subjected to additional harvesting in the appropriate terminal area.

The following describes, for the period 1994 – 2001 period, the "Clockwork" strategy, PST requirements for Inside chum and discusses Inside, Fraser River, and mid Vancouver Island chum stocks in relation to these plans.

#### *3.3.1 Clockwork Harvest Strategy for Johnstone Strait*

This strategy is described in the final 1985 Post Season Summary Report of the Joint Chum Technical Committee (TCCHUM 87-4). The Clockwork strategy is designed to rebuild wild chum stocks to the estimated optimum escapement levels by limiting the overall harvest rate. For years 1983 to 1998 the specific objectives of this strategy were to:

- a. achieve the rebuilding objective within 12 to 15 years: the optimum wild escapement objective is defined to be 2.5 million chum;
- b. reduce the number of years during which no commercial chum fishing is permitted;
- c. consider wild stock production when establishing harvest management plans.

Under Clockwork strategy, harvest rates are directly related to the total run size of the chum run migrating through Johnstone Strait as estimated during the season. The allowable harvest rates for the expected magnitudes of chum salmon run sizes for the following years are present in Table 1.



Table 1. Clockwork harvest rate schedule.

YEARS	1983-1986.		
	Wild Stock	Total Stock	Harvest Rate
	0 - 1.8 million	0 - 2.6 million	10%
	1.8 - 2.5	2.6 - 3.3	20%
	2.5 - 4.0	3.3 - 4.8	30%
	over 4.0	over 4.8	40%
YEARS	1987-1991.		
	Wild Stock	Total Stock	Harvest Rate
	0 - 2.0 million	0 - 3.0 million	10%
	2.0 - 2.7	3.0 - 3.7	20%
	2.7 - 4.2	3.7 - 5.2	30%
	over 4.2	over 5.2	40%
YEARS	1992-2001		
	Wild Stock	Total Stock	Harvest Rate
	0 - 2.0 million	0 - 3.0 million	10%
	2.0 - 2.9	3.0 - 3.9	20%
	2.9 - 4.2	3.9 - 5.2	30%
	over 4.2	over 5.2	40%

The first Clockwork review occurred in 1986 resulted in some major changes to the total stock threshold points. The chum run harvest rate thresholds were again reviewed in 1991 and new thresholds were established for 20 and 30 percent harvest rates.

The Clockwork strategy was developed to limit the harvest in those areas containing numerous mixed stocks and it was recognized that harvesting in terminal areas would be required, particularly in areas of major enhancement.

The next Clockwork review examined the assessment of Inside chum stocks and the corresponding fishery management for the period 1983 through 1997 (PSARC 99/169 Ryall, et al. 1999). The purpose of the review was to provide: 1) an up to date stock-recruit analysis, including the large 1997 returns, for both Fraser and non-Fraser Clockwork stocks. The analysis focused on wild stocks but an assessment of the enhanced component was also presented: 2) an updated assessment of escapement patterns: 3) an updated assessment of the Mission fry estimates and it's relationship to subsequent returns: 4) a retrospective analysis of in-season run size estimates in Johnstone Strait: and 5) a review of the fishery management with respect to the effectiveness of the Clockwork management strategy.

Stock-recruit analysis was done on the 1959-1992 brood years for wild Fraser and non-Fraser Clockwork chum. Results show that for Fraser River chum, the optimal harvest rate is approximately 45%, which is almost identical to that found by Joyce and Cass (1992 PSARC 92-02). However, unlike the earlier report, the optimal stock size was found to be 738,690, which is substantially larger than 485,320 estimated, by Joyce and

Cass. Further, evidence of density dependence was found for Fraser stocks that was not found in earlier work. For the aggregate wild stocks, the optimal harvest rate was 44% with optimum stock size calculated at 2.6 million and evidence for density dependence was also noted.

Chum escapement patterns and production has varied between stocks. For the overall aggregate, production has increased. However, it would appear that not all areas have responded equally. Fraser River chum stocks have shown greater production and increased escapement relative to the other stocks and are driving the aggregate. Some stocks appear to be decreasing in spite of management and conservation actions. Specifically, escapement records to Upper Vancouver Island, Kingcome Inlet, Bond and Knight Inlets and Toba Inlet have exhibited a decline in escapement levels and have not responded to the Clockwork management plan. Natural rebuilding of these stocks may only occur if harvest rates are further reduced.

Heuristic analysis of the predictive ability of downstream fry data at Mission indicated that, although the data correlates with subsequent stock size, it is still too variable to be considered a useful tool for prediction.

The magnitude of the returning Inside chum run was assessed by three methods. First, the pre-season forecast derived from return/spawner, fry survival, etc. Second, the correlations between commercial fishery catch and total run size. Lastly, the correlation between Johnstone Strait test fishery catch and total run size.

Six models (derived from the three assessment methods) were tested and analyzed as to their value for in-season stock size estimation. In general, no one model performed markedly better than any other model. Although run size estimates have been reasonably accurate in comparisons to the final run size, there have been a number of years when the in-season and final estimates have been significantly different. The current models are using the assumption of average migratory timing of the Clockwork chum stocks. In-season models based upon average migratory timing will under or over-forecast population abundances because of run timing variability.

A number of review findings are of interest to the management of the Inside chum salmon fishery. Firstly, there is the generally poor performance of the pre-season forecast. Its utility for helping to manage Clockwork stocks is extremely questionable. This was evident during the 1995-97 period when the pre-season forecast was greater than 4.2 million and the actual return was less than 1.5 million. Second, there was the noted result of over-estimating the actual magnitude of the returning Clockwork chum salmon run size. This tendency to over-estimate persists over the three time strata examined (pre, mid and end of season) but was at a minimum during the peak of the run. This tendency to over-estimate has the potential effect of scheduling additional harvest when no surplus exists.

The third important finding from this review was that while the mean absolute percent error (MAPE) averaged 12-20% using the commercial fishery models at the peak of the

season there were still 4 years out of 10 that over-estimated the run size by 60-70% using the test fishing models. While these current models have had a tendency to over-estimate the run size and potentially create a 'paper' surplus, the stepped harvest rate management regime in place for the Clockwork chum salmon ameliorates the over-estimation problem. When the levels for the various harvest rates were being developed it was recognized that in-season estimates were not very reliable and consequently conservative harvest rates were set. For example, in 1995 the run size was consistently over-estimated with the mid-season estimate of 2.5 million versus an actual return of only 1.5 million or an over-estimate of 62%. However, since the first harvest step of 20% did not take effect until run sizes of greater than 3.0 million were estimated, no fisheries were scheduled.

The effectiveness of the Clockwork management strategy requires accurate estimates of catch and escapement. Naturally the reliability of the Clockwork management strategy depends upon the quality of these data. While the catch statistics are considered reasonably easy to obtain and are consistently collected, the same cannot be said for the escapement data. There are a large number of streams contributing to Inside chum salmon and a wide variety of escapement methodologies applied. The accuracy and frequency of escapement estimates within years and among streams is highly variable. Uncertainty in both catch and escapement affects the results of in-season management and therefore the usefulness of the Clockwork strategy in managing Inside chum salmon.

Recommendations from the 1999 PSARC Clockwork review, and additional issues and concerns raised by fisheries managers, First Nations, stakeholders and the commercial fishing industry, highlighted the need for further consultations and an in-depth technical review of the Clockwork strategy. The following issues and concerns were assessed in the technical review during 2000 and 2001: 1) in-season run size methodology, accuracy, precision and usefulness; 2) test fish program and operation; 3) stream enumeration and catch monitoring scope, adequacy, accuracy and uncertainty; 4) inconsistent use of stock identification program; 5) affects of future reductions in chum enhancement production; 6) affects of the loss of the third week of September fishery for assessment of returning stock size (no assessment fishery in 1998 or 1999 because of coho conservation); 7) affects of changes to the Clockwork rules on timing and duration of fishery openings; and 8) need to review, formalize and ratify a new the in-season advisory process.

After extensive technical reviews and several years of discussions with First Nations, stakeholders and the commercial fishing industry, CDFO announced significant changes to the Inside chum salmon management approach and replaced the Clockwork stepped exploitation rate approach in favour of a stable fishing schedule designed to approximate a fixed exploitation rate (<20%). These changes were implemented in the 2002 season.

### *3.3.2 Fraser River Chum Management Strategy*

Chum salmon produced from the Fraser River were of major importance during the development of the Clockwork harvest strategy and the negotiation of the PST. While the Johnstone Strait Clockwork plan was designed to conserve all Inside chum in the Johnstone Strait mixed stock fishery area, this strategy potentially resulted in terminal Fraser River surpluses. As part of the revisions to the 1988 Johnstone Strait Clockwork, terminal harvesting of Fraser River chum was no longer directly linked to the harvesting pattern in Johnstone Strait. Fraser River harvest would be dependent on abundance assessments by two in-river test fisheries, at Cottonwood and Albion. Since 1992, there has only been one test fishery (at Albion), the test fishery at Cottonwood was dropped. The removal of the linkage to Johnstone Strait required the adoption of a harvest management plan specifically for the Fraser River (Area 29) and relying solely on Albion test fishery catches.

The harvest management plan for Fraser River chum was implemented to provide management goals and fishing limits for the harvest of Fraser River chum in the terminal area. The terminal run was further divided into early and late segments with escapement goals and harvest guidelines set independently for each segment. In 1992, the minimum gross escapement goal for the early and late segments was set at 390,000 and 350,000 respectively, including First Nations Fish and test fishing requirements. The plan provided for either escapement goal to be increased in season if the return exceeded the escapement goal. For the early chum run, the harvest was not to exceed 10% on a terminal run size in the range of 425,000 to 550,000 and for a terminal run of over 550,000 the harvest rate was increased to 15%. For the late chum run, the harvest was not to exceed 10% on a terminal run size in the range of 385,000 to 500,000 and for a terminal run of over 500,000 the harvest rate was increased to 15%. This allowed an upward scaling of the escapement goal with an increase in the run size. In 1999 the total escapement goal (following two recommendations from PSARC, 1992 and 1999) was increased to 800,000 and the early and late run escapements were increased proportionately. There continues to be discussion regarding the validity early and late components (Table 2).

#### *3.3.2.1. Fraser River Clockwork Management Rules*

**Rule 1.** Directed harvest will not occur unless cumulative test fishing catches predict that the abundance of early or late chum exceeds the gross escapement goal for the respective period. For computational purposes, a commercial fishery within the river will be considered to harvest a minimum of 35,000 chum. The harvest rate schedule (Table 2) will be used to determine the available surplus (escapement Goal = 800,000).

Table 2. Clockwork harvest rate schedule for the Fraser River.

RUN TIMING	TERMINAL RUN SIZE	MANAGEMENT	POTENTIAL CATCH
Early Oct. 1 – Nov. 12	445,000 - 550,000	Minimum Gross Escapement Goal* = 410,000; one opening not to exceed 10% harvest rate	35,000 - 55,000
	>550,000	Set harvest rate at 15%	82,500+
Late Nov. 13 - Dec. 20	370,000 - 500,000	Minimum Escapement Goal* = 350,000; one opening not to exceed 10% harvest rate	35,000 - 50,000
	>500,000	Set harvest rate at 15%	75,000

\* (Gross Escapement Goal = Net Escapement + Test Catch + Native Harvest)

**Rule 2.** Albion test fishing data will be used to determine the timing of commercial openings. Under most circumstances, two weeks of test fishing data (until October 15) are required to establish the predicted run size. Since 1990 the relationship between run size and test fishing catch was based on data collected daily between 1979 and 1989. The relationship was recalculated in 1999 to incorporate data collected to 1998. In 1998 and 1999, in order to reduce coho by-catch, the test fishery only operated on alternate days. Because of the fewer number of fishing days it may, in some years, take longer than 2 weeks to estimate the run size.

**Rule 3.** The standard openings for directed chum harvesting are inside the river (29-11 through 29-17). Areas 29-1 through 29-10 may remain closed to limit interceptions of other passing chum stocks.

**Rule 4.** The daily chum openings will be structured to avoid night fishing. The duration of the fishery will be adjusted to harvest the target catch.

**Rule 5.** Whenever practical, 24 hours notice will be given for openings, however, shorter notice may sometimes be required. Notices to Industry advising of run status and possible management actions will be issued when appropriate.

**Rule 6.** The minimum mesh size of 100 mm (approximately 4”), in place since at least 1988, was changed to 158 mm (approximately 6.25”) in 1995 and remains in effect to date.

**Rule 7.** Area E (gillnet) license conditions include fish slips, observers, logbooks, hails, revival tanks, etc. In-season advisors will be updated on current status through conference calls.

**Rule 8.** Conservation of Thompson River coho became a major issue in 1997 and will likely remain so for the foreseeable future. Fishing restrictions between Aug. 29 and Oct. 15 in Area 29 can be anticipated. Conservation of Thompson and Chilcotin River steelhead will result in fishing restrictions in later October and possibly early November. Potential low returns of Harrison River chinook are also a consideration.

**Rule 9.** Since 1997, the Province of British Columbia has used Albion test fishing data to estimate the abundance of four indicator stocks of Thompson and Chilcotin River steelhead. Each stock is assessed as either “above average” or “below average” (see Table 3). Test fishing data up to and including October 24 is required to generate the escapement estimates. In the event that the steelhead escapement estimates for all four stocks are above average, the Province will consider fishing opportunities in Area 29 starting November 1. Should the escapement estimate for any one stock be “below average”, the Province will request fishing opportunities be delayed in Area 29 until November 9.

Table 3. Escapement minimums for Thompson and Chilcotin River steelhead.

STOCK	ABOVE AVERAGE	BELOW AVERAGE
Chilko	Escapement >910	Escapement <910
Nicola	Escapement >1060	Escapement <1060
Bonaparte	Escapement >300	Escapement <300
Deadman	Escapement >330	Escapement <330

### 3.3.2.2. Fraser River In-season Run size estimation

The test-fishery has operated at Albion on the Fraser River since 1978 to provide the means for an index of chum salmon abundance (escapement) within a season. Recent degradation of the accuracy and consistency of escapement estimates has seriously undermined the potential to evaluate Clockwork management for the Fraser River chum salmon (PSARC paper S99-20, Ryall et al. 1999). To address this problem the cumulative catch-per-unit-effort (CPUE) was calculated to account for saturation, depletion in the second set and interpolation for missing sampling days. In addition, the test-fishery data were cast into a Bayesian framework that incorporated preseason knowledge of run size and migration timing, with in-season information on migration timing and a predictive regression to calibrate run size to the historical record. Based on a retrospective analysis of 1979-1998 data, the Bayesian procedure was judged to be superior to the classical test fisheries approach of using a simple predictive regression of cumulative CPUE on run size. However, the predictive ability of the either model was seriously compromised by the reliability of escapement enumeration. The new Bayesian procedure for estimating in-season Fraser River chum run size has been in use since the 2000 fishing season.

### 3.3.3 Strait of Georgia Chum Management Strategy

Chum salmon stocks returning to the Strait of Georgia terminal areas are directly affected by the harvest in Johnstone Strait. A portion of this return is harvested in Johnstone Strait, under the Clockwork harvest strategy. The chum produced in mid Vancouver

Island (Area 14) are primarily from enhancement facilities. Terminal harvesting is directed at a mix of surplus mid Vancouver Island wild and enhanced chum, with the conservation requirements of passing chum stocks considered. Conservation requirements of local chinook and coho salmon in this fishery area are also considered in the determination of area closures for the Area 14 chum fishery.

Other terminal areas in the Strait of Georgia are assessed for their abundance and terminal harvest occurs when surpluses are identified.

### **3.4 Run Size Estimation**

Preseason run size forecasts are prepared to facilitate the planning of potential conservation actions as well as domestic and international allocations. As the season progresses, revisions to the run size projection are used to alter harvest plans in accordance with the Clockwork approach.

#### *3.4.1 Preseason*

The number of Clockwork chum returning to enhanced spawning areas is determined through the application of average survival rates by enhancement facility and the average returns by age to the number of fry released by the facilities.

#### *3.4.2 In Season*

The abundance of chum in Johnstone Strait is assessed, in part, through test fishing by two seine vessels in Area 12. The test fishing in Area 12 normally begins in early September and continues until early November.

The Area 12 test fishing data are utilized to determine relative weekly chum abundance and the magnitude of the total run entering Johnstone Strait. The relationship between CPUE in the test fishery and the total run size is monitored weekly throughout October to assist in the determination of the in season estimates of the run size.

Terminal surpluses are estimated using information from escapement, test and commercial harvesting. Areas for potential terminal fishing in the Strait of Georgia occur at mid Vancouver Island (Area 14), Jervis Inlet (Area 16), Nanaimo (Area 17) and Cowichan (Area 18).

Initial estimates of the Fraser River total run size are made from Johnstone Strait commercial and test fishing assessments combined with GSI estimates, if available. Fraser River test fishing is used after mid October to estimate the return to the terminal area. Test fishing on the Fraser River is normally conducted from October 1 to early December.

#### *3.4.3 Post season*

The total chum catch in all inside areas (including the catch of Canadian chum in U.S. Areas 7 and 7A) plus Inside chum gross escapements are summed to estimate the total Clockwork assessed run size.

An evaluation table of Clockwork management goals, stock sizes, catch, escapement and harvest rates is presented in Table 4.

Table 4. Assessment of Clockwork Management 1994 - 2001.

	1994	1995	1996	1997	1998	1999	2000	2001
<b>1. IN-SEASON</b>								
Inseason Assessment Total Stock	4,610,000	3,000,000	2,700,000	2,500,000	5,500,000	2,900,000	2,300,000	2,600,000
Date Assessed	Oct 17	Oct 27	OCT 30	Oct 24	Oct 29	Oct 11	Oct 6	Oct 22
Assessed Total Stock	4,895,000	3,019,000	2,789,600	2,884,000	5,500,000	2,700,000	2,184,079	2,918,574
Desired HR	30.0%	20.0%	10.0%	10.0%	40.0%	10.0%	10.0%	10.0%
Apparent HR	31.6%	12.7%	4.0%	4.5%	29.6%	2.1%	8.9%	8.5%
<b>2. POST-SEASON</b>								
Total Clockwork Assessed Stock	5,068,539	2,686,290	1,530,952	2,478,790	7,013,120	3,548,252	1,140,800	3,123,033
Clockwork Assessed Catch								
COVM& TF A11-13	1,272,492	285,135	77,781	82,932	1,521,725	40,910	185,997	188,241
COVM& TF A29	-	initiation of Fraser terminal strategy				-	-	-
IFF A11-13,29	109,986	57,505	30,141	29,856	12,456	21,130	17,877	23,672
US 7-7A	60,907	37,108	86	211	30,791	75	5	3,077
COVMA14 FR	13,484	1,956	0	0	61,640	0	17	4,739
Total JS Clwk Catch	1,456,869	381,704	108,008	112,999	1,626,613	62,115	203,886	219,729
Desired HR	30.0%	10.0%	10.0%	10.0%	40.0%	20.0%	10.0%	20.0%
Actual HR	28.7%	14.2%	7.1%	4.6%	23.2%	1.8%	17.9%	7.0%
<b>3. ESCAPEMENT (WILD)</b>								
Goal	2,500,000	2,500,000	2,500,000	2,500,000	2,500,000	2,500,000	2,500,000	2,500,000
Estimated wild	2,483,616	2,014,242	1,154,008	2,037,315	4,262,892	3,079,147	836,497	2,504,868
Difference	(10,000)	(950,000)	(1,345,992)	(462,685)	1,762,892	579,147	(1,663,503)	4,868

### 3.5 Catch / Fishery

Fall-run chum salmon in Inside waters are harvested by commercial, First Nations, and test fisheries. Commercial catch of chum in Inside waters occurs in three main areas: Johnstone Strait, Strait of Georgia and the Fraser River. The Johnstone Strait fishery (Areas 11, 12 and 13) normally begins in July and ends in late September. During the July and August period, the Johnstone Strait fishery is directed at harvesting Fraser River sockeye and pink salmon. During these two months, some chum salmon are harvested (Table 5). These chum are assumed to be comprised mainly of summer-run chum destined for streams in the Johnstone Strait and Canadian central coast areas and are not part of the Clockwork management plan. The annual catch is presented by each fishing group (Commercial, Test, First Nation) and area (Johnstone Strait, Strait of Georgia, and Fraser River).



Table 5. Catch of chum salmon by statistical area for Commercial, First Nation and Test Fishing vessels (July through August).

Year	Stat Week	Statistical Area					Year Total
		18	19	20	21	29	
1994	7/1 - 8/4	0	0	703	91	45	839
1995	7/1 - 8/4	0	0	797	84	268	1,149
1996	7/1 - 8/4	0	0	528	3	364	895
1997	7/1 - 8/4	0	0	381	0	165	546
1998	7/1 - 8/4	0	0	50	0	4	54
1999	7/1 - 8/4	0	0	35	0	0	35
2000	7/1 - 8/4	0	0	37	0	39	76
2001	7/1 - 8/4	0	0	27	0	12	39
Area Total		0	0	2,558	178	897	3,633

### 3.6 Escapement

Chum salmon that escape the commercial, test, sampling, and First Nation's fisheries form the gross escapement to Inside chum streams. This gross escapement is made up of chum which spawn in wild areas, those which are spawned in enhancement facilities, and those which are surplus to facility requirements and are removed from the spawning areas. Gross escapement estimates are used in reconstruction of the total run size in a given year.

#### 3.6.1 Spawning

Some of the streams within the Inside area contain summer run spawners. These are relatively minor stocks and because of their distinctively early run timing in Johnstone Strait, i.e. July to late August, are not included in the escapement total for the fall chum run.

The primary enhanced escapement areas are presently limited to the mid Vancouver Island and Fraser River areas. The enhancement facilities in the mid Vancouver Island consist of those on the Big Qualicum, Little Qualicum and Puntledge rivers. In the Fraser River enhancement facilities are located on the Inch (Inch and Stave stocks), Chilliwack, Chehalis and Weaver rivers however production from the Fraser facilities has declined sharply recently as resources are channelled elsewhere.

The stocks which are managed within the context of the Clockwork plan are the fall run chum. These chum enter Johnstone Strait during the September to November time period.

The total Inside chum stock of wild and enhanced of both Fraser and non-Fraser escapement since 1990 are presented in Table 6.

Table 6. Inside chum spawning escapement for wild and enhanced stock groupings (Fraser and Non-Fraser) for 1994-2001.

	1994 Estimate	1995 Estimate	1996 Estimate	1997 Estimate	1998 Estimate	1999 Estimate	2000 Estimate	2001 Estimate
Fraser (Wild)	1,485,125	1,560,398	680,650	1,468,356	3,439,904	2,796,400	645,014	1,761,489
Fraser (Enhanced)	122,524	48,862	98,260	64,195	107,876	92,040	35,420	100,000
NonFraser (Wild)	998,491	453,844	473,358	568,959	822,988	282,747	191,483	743,379
NonFraser (Enhanced)	339,422	103,171	72,612	165,104	344,011	109,973	22,436	162,391
<b>WILD TOTAL</b>	<b>2,483,616</b>	<b>2,014,242</b>	<b>1,154,008</b>	<b>2,037,315</b>	<b>4,262,892</b>	<b>3,079,147</b>	<b>836,497</b>	<b>2,504,868</b>
<b>ENHANCED TOTAL</b>	<b>461,946</b>	<b>152,033</b>	<b>170,872</b>	<b>229,299</b>	<b>451,887</b>	<b>202,013</b>	<b>57,856</b>	<b>262,391</b>

### 3.7 Annual Detailed Inside Summaries

The annual detailed summaries are descriptions of the run size and harvest strategies on a weekly or commercial fishery basis. The description contains run size forecasts, commercial opening times, harvest rate goals, and commercial and First Nation catches.

#### 3.7.1 1994 Season

Pre-season expectations indicated a total inside run size of 4.2 million chum salmon.

##### Johnstone Strait

There were three directed commercial chum fisheries in Johnstone Strait in 1994. The first occurred on September 25 - 27 (seines 24 hours, gill nets 40 hours). The catch for this assessment fishery was 228,100. This, combined with earlier test fishing results, indicated a run size of 3.8 million, which would allow for a 20% harvest rate under the Clockwork strategy. However, even at a 20% harvest rate, additional TAC was still available in Johnstone Strait. In addition, test fishing catches picked up after the assessment fishery indicating that the 3.8 million run size estimate might be conservative. A second fishery was conducted on October 10 - 12 (seines 7 hours, gill nets 40 hours) which harvested a further 536,700 chum salmon. Subsequent run size assessment indicted a total Clockwork chum run of greater than 3.8 million. Test fishing continued following the second commercial fishery and recorded some of the highest catches of the season (and in the history of the test fishery). Based on this information and the good commercial catch in the previous week the run size estimate was upgraded on October 17 to 4.609 million. Under the Clockwork strategy the allowable harvest rate increased to 30% with a commercial TAC of 1.207 million compared to the pre-season TAC of 1.091 million at a run size of 4.205 million. By October 17, the Johnstone Strait commercial Clockwork catch totalled 790,500 (including a troll catch of 19,900). The third and final Clockwork fishery occurred October 23 - 26 (seines 9.5 hours, gill nets 66 hours) and caught 482,000

chum. The total 1994 commercial catch estimate for Johnstone Strait was 1,272,500 which includes 5,700 chum caught in early September fisheries. First Nation catch totalled 25,200.

#### Strait of Georgia

In Qualicum (Area 14), there was a total catch of 368,800 chum for the following six openings; October 22 (gill nets 24 hours), October 29 (gill nets 48 hours), November 5 (gill nets 24 hours), November 19 (gill nets 96 hours extended to the following week for 64 hours), November 26 (seines 55 hours). Terminal fisheries in Jervis Inlet (Area 16) and Satellite Channel (Area 18) did not occur due to low escapements. In Nanaimo (Area 17), there was one 24 hour gill net fishery on October 29 for a catch of 8,500 chum. The total 1994 commercial catch estimate for Strait of Georgia was 378,500 (including a troll catch of 500). First Nation catch was 6,700.

#### Fraser River

The early run size, based on test fishing was estimated at 800,000 chum on October 21. A commercial fishery occurred on October 26 and caught 39,400 chum. As the early run size estimate maintained its strength (980,000, October 28) another commercial fishery on November 1 caught an additional 74,100 for a total of 113,500. The late run size was estimated at 464,000 on November 11 and the last commercial fishery of 1994 was held on November 14 and caught 8,300 chum. The total 1994 commercial catch estimate for Fraser River was 130,800 (including a negligible troll catch and incidental chum catch of 8,900). First Nations harvested was 34,000.

### 3.7.2 1995 Season

The 1995 Clockwork pre-season expectations indicated a total inside run size of 4.2 million chum salmon.

#### Johnstone Strait

There were two directed commercial chum fisheries in Johnstone Strait in 1995. The first occurred on September 25-26 (seines and gill nets 24 hours). The catch for this assessment fishery was 67,800. The assessment fishery catch combined with earlier test fishing results, indicated a run size of 1.8 million, which allowed for a harvest rate of up to 10% under the Clockwork management plan. Test fishing continued to be poor through to October 8. A reassessment of run size was done October 8 and the run size was increased to 2.2 million. Test fishing generally improved after October 8 and the run size was reassessed again on October 27. Using test fishing information and the September assessment fishery the run size was determined to be 3.0 million. This allowed for a second commercial opening to be held October 31 to November 2 (seines 8 hours, gill nets 42 hours) which harvested a further 120,000 chum salmon. Test fishing continued following the second commercial fishery and low numbers of chum salmon were observed. The total 1995 commercial catch estimate for Johnstone Strait was 285,100 (including a troll catch of 50,300 and incidental chum catch of 34,600). In addition, 20,100 chum were taken by First Nation's fisheries.

#### **Strait of Georgia**

There were no terminal chum fisheries at Jervis Inlet, Nanaimo, or Cowichan due to low escapement counts and poor test fishing results. The only terminal fishery was a one day gill net fishery in Area 14 for a catch of 18,300. Escapement for the Big and Little Qualicum and Puntledge Rivers totalled 30-35,000 with a target escapement of 290,000 for the three systems. The total 1995 commercial catch estimate for Strait of Georgia was 21,500 (including a troll catch of 2,800 and incidental chum catch of 400). First Nation catch totalled 5,600.

#### **Fraser River**

The early run size, based on test fishing was estimated at 510,000 chum and at this run size one commercial fishery was permitted on October 31. The total catch in this fishery was 45,000. Late run assessments continued with poor test catches. Late run strength did not exceed 200,000. Based on a minimum escapement goal of 335,000, no further commercial fisheries were conducted. The total 1995 commercial catch estimate for Fraser River was 53,000 (including a negligible troll catch and incidental chum catch of 8,000), primarily of early-run fish. The First Nation fishery in the lower Fraser River caught 33,300 chum.

### ***3.7.3 1996 Season***

The 1996 pre-season forecast for Clockwork chum stocks was 4.1 million based primarily on 1992 brood year returns. This forecast consisted of 1.7 million Fraser and 2.4 million non-Fraser.

#### **Johnstone Strait**

Following the Johnstone Strait Clockwork Strategy, a one day commercial assessment fishery occurred in Areas 12 and 13 on September 23/24. The catches totalled 63,200 chum salmon. This commercial catch and test fishing indicated a total run through Johnstone Strait of 1.9 million (October 3). Subsequent run sizes updates included; 2.3 million on October 17 and 2.7 million on October 30. The final in-season run size was estimated at 2.6 million. No commercial fisheries occurred in Johnstone Strait after the September assessment fishery. The total 1996 commercial catch estimate for Johnstone Strait was 77,800 (including incidental catches of 14,600). The First Nation's fishery in Johnstone Strait (Areas 12 and 13) caught 22,000 chum. Test fishing catches for all areas totalled 18,000.

#### **Strait of Georgia**

No commercial fisheries occurred in these areas. First Nations catches were estimated at 2,000. The Strait of Georgia incidental commercial catch total for 1996 was 1,300.

#### **Fraser River**

Test fishing began on the first of September, 1996 and harvested 5,275 chum. The run timing appeared to be normal, but the run size was well below the preseason forecast of 1.7 million. The total terminal run estimated from test fishing was 518,000, well below the escapement objective of 700,000 and insufficient to support commercial fisheries.

Fisheries by First Nations were delayed to conserve steelhead and took place between October 20 and November 17 from the Fraser River mouth to Sawmill Creek (6 km above Yale and near the upstream limit of chum spawning on the Fraser). The total catch by First Nations was 9,400 chum. Two experimental fisheries to selectively harvest chum with beach seine and tangle nets, while releasing other species, were conducted on the lower Fraser between October 1 and November 12. These two experimental fisheries caught 7,200 chum. The 1996 Fraser total commercial catch was 21,875 chum.

#### 3.7.4 1997 Season

The pre-season forecast for Clockwork chum stocks was 4.9 million based on 1992-94 brood year returns. This forecast consisted of 1.9 million Fraser and 3.0 million non-Fraser.

##### Johnstone Strait

A one day commercial assessment fishery (purse seines only) occurred in Areas 12 and 13 on September 21/23. The catches totalled 35,500 chum salmon.. This commercial catch and subsequent test fishing indicated a total run through Johnstone Strait of 2.5 million (October 7). No further commercial fisheries were scheduled at this run size. The total 1997 commercial catch estimate for Johnstone Strait was 82,900 (including troll catch of 1,600 and test fishing catch of 44,700). The final in-season run size was estimated at 2.5 million salmon. The First Nations fishery in Johnstone Strait (Areas 12 and 13) caught 18,700 chum.

##### Strait of Georgia

Stock assessment information indicated that fisheries were unlikely in these areas because of low escapement levels. The escapement to indicator systems was less than half of the goal. Area 15 (Jervis), Area 17 (Nanaimo), and Area 18 (Cowichan) were closed to commercial fishing. Area 14 (Qualicum) escapement levels into the Big and Little Qualicum Rivers were well below escapement requirements and test fishing in the terminal areas did not indicate a large number of chum holding in the area. The Strait of Georgia incidental commercial catch total for 1997 was 600 chum. First Nations catches in Areas 14 to 19 areas were negligible.

##### Fraser River

Test fishery catches totalled 3,700 chum. By November 5, the run timing was still uncertain; there were indications that the run was late but catches in the Johnstone Strait seine test fishery did not support this conclusion. The run size was below the pre-season forecast of 1.9 million. The total terminal run was estimated at 712,000, with an early run component of 484,000 and a late run component of 228,000. Fisheries by First Nations started on October 25 between the Fraser River mouth and Sawmill Creek (6 kilometres above Yale and near the upstream limit of chum spawning on the Fraser). The catch, based on hails and First Nations landing slips was 4,300, including ceremonial catches. An Area 29 commercial fishery for chum took place on November 6 resulting in a catch of 14,700.

Experimental fisheries to test methods of selectively harvesting chum while releasing other species were conducted on the Lower Fraser between September 1 and November 12. The modified gill net fishery harvested 4,500 chum; the tangle net fishery harvested 1,000 chum to November 8; the beach seine harvest was very small. The 1997 Fraser commercial catch total was 20,200.

#### 3.7.5 1998 Season

The 1998 pre-season forecast for Clockwork chum stocks was 3.8 million based on 1993-95 brood year returns. This forecast consisted of approximately 1.9 million Fraser and 1.8 million non-Fraser

##### Johnstone Strait

In 1998, the third week of September "assessment fishery" was not held due to conservation concerns for coho salmon. The cancellation of the assessment fishery was just one management action taken among a broad spectrum of measures taken in order to reduce exploitation on Southern B.C. coho stocks. However, this action forced total reliance upon test fishing in Johnstone Strait as the only means for assessing the returning chum run stock strength early in the season. Test fishing commenced on September 16 in Johnstone Strait. Test fishing catches were strong in the first week and continued strong into the second week. In fact, one of the test vessels had the highest catches on record since test fishing commenced in 1965. Given the strong test fishing catches and the pre-season forecast, gill net and troll fisheries were initiated to harvest returning chum salmon.

On October 8 the run was reassessed. The reassessment resulted in a run size upgrade to 5.1 million from the pre-season forecast of 3.9 million.

In 1998, there were the following Johnstone Strait chum fisheries. Purse seines fished a total of 8 days spread over 5 weeks. The total catch for the eight days of seining was 1,327,200. Gill nets fished a total of 26 days spread over 6 weeks. The first fishery was on October 5 and the last was November 13. Total catch for the 26 days was 99,200. Troll fishing for chum salmon in Johnstone Strait commenced on October 8 and was closed November 20. There was a total of 33 days of trolling for chum salmon in 1998. During this period the total troll catch was 95,300. The total commercial catch was 1,521,700. First Nation catch totalled 2,500. The test fishery catch was 26,000.

##### Strait of Georgia

At Qualicum (Area 14), fishing commenced on October 19 for two days by gillnets. Fishing by gillnets resumed on October 26 for four days and on November 2 was extended until further notice. Gillnet participation was low. Seine fishing occurred on November 1 and 2, and resumed November 8 until November 20.

Gillnets opened for two days commencing on November 3 in Jervis Inlet (Area 16), and resumed again the following week for four days starting on November 8. Seines opened for two days commencing November 13. Escapement met or exceeded escapement goals.

A Nanaimo (Area 17) gillnet fishery occurred on November 2 for 24 hours. Effort was low. Escapement estimates were average in the Nanaimo River. A Cowichan (Area 18) gillnet fishery occurred on November 9 and 10. Catches and effort were small.

The total 1998 commercial catch estimate for Strait of Georgia was 563,300 (including a troll catch of 500, a gillnet catch of 28,100 and a seine catch of 534,600). First Nations catches were 18,000.

#### Fraser River

Test fishing at Albion began on September 1 and by November 15, test fishery catches totalled 10,700 chum. The run size appeared to be above the pre-season forecast of 1.9 million. The total terminal run, including catch to November 11, was estimated at 2.2 million, with an early run component of 1.5 million and a late run component of 714,000. Area 29 commercial fisheries took place on November 9, 12 and 19 and the total catch was 18,800. Fisheries by First Nations caught 16,000 chum approximately 4,500 of which were taken in selective fisheries initiatives. Another 26,000 chum were taken in an ESSR (Excess Salmon to Spawning Requirements) fishery.

#### 3.7.6 1999 Season

The 1999 pre-season forecast for Inside chum stocks was 2.5 million based on 1994-96 brood year returns. This forecast consisted of 1.7 million Fraser and 0.8 million non-Fraser.

#### Johnstone Strait

In 1999, the third week of September "assessment fishery" was not held. Test fishing commenced on September 15 in Johnstone Strait. On October 7 the run was reassessed resulting in a run size upgrade to 2.9 million from the pre-season forecast of 2.5 million. This run size estimate was reviewed weekly, however test fish catches were low indicating a low abundance of fish in Johnstone Strait. As the 2.9 million run size estimate remained unchanged, there was no opportunity for a commercial fishery in Johnstone Strait in 1999.

The total catch of Johnstone Strait chum from First Nations Fishery was 21,100.

#### Strait of Georgia

Test-fishing continued for most areas but no fishable commercial surplus was identified. The First Nations FSC catches for Areas 16 through 19 were 3,900 chum. The incidental commercial catch total was 100 chum.

#### Fraser River

Test fishing at Albion began on September 1 and catches totalled 8,776 chum. The run size was lower than the pre-season forecast of 1.9 million. The preliminary total terminal run, including catch, was estimated at 1.2 million, with an early run component of 810,000 and a late run component of 400,000. However, the estimate of the late run

component was strongly influenced by the early run size. Catches in the test fishery after November 5 dropped precipitously and the final late run size estimate was less than 280,000. The catch for First Nations was 40,000 chum, approximately 2,600 of which were taken in selective fisheries. Another 40,000 chum were taken in ESSR fisheries. An Area 29 commercial fishery took place on November 3 resulting in a total catch of 21,100 chum. The Fraser River commercial catch total for 1999 was 31,300.

### *3.7.7 2000 Season*

#### **Johnstone Strait**

Test fishing was the main assessment tool for the Johnstone Straits area. Test fishing data through early October indicated a total return of 2.2 million. However, subsequent assessments provided total returns of less than 2.0 million. As outlined in the Pacific Salmon Treaty, the harvest rate in Johnstone Strait is limited to 10% for run sizes less than 3.0 million.

The following fisheries were conducted as indicated in the preseason plan:

- A 12 hour seine fishery on October 2 for a total catch of 172,300 chum.
- A 24 hour gillnet fishery on October 6, for a total catch of 6,700 chum.
- A 24 hour troll fishery on October 9 for a total catch of 900 chum.

The total Johnstone Strait commercial catch was 186,000 (including incidental catch of 6,100). First Nation catch was 14,900. Based on the in-season estimate of total return the exploitation rate in Johnstone Strait was less than 10%.

#### **Strait of Georgia**

Escapements to all terminal areas were significantly below target and no fisheries were opened. First Nation catch totalled 2,100.

#### **Fraser River**

Test fishing at Albion began on September 1 and catches totalled 5,582 chum to Nov. 20. The run size was lower than the pre-season forecast of 1.6 million. The preliminary total terminal run was estimated at 940,000, with an early run component of 640,000 and a late run component of 300,000, based on a new Bayesian model being tested. Catches in the test fishery after November 2 dropped precipitously. The preliminary catch for First Nations was 22,000 chum to week ending Nov. 12, approximately 500 of which were taken in selective fisheries. An Area 29 commercial fishery took place on November 2 resulting in a total catch of 4,500 chum.

Experimental fisheries designed to test methods of selectively harvesting chum while releasing other species were undertaken in the Fraser River. The majority of the projects were trials of non-retention equipment. The harvest from these experimental fisheries was approximately 11,700 chum, bringing the 2000 Fraser River commercial catch total to 16,200.



### 3.7.8 2001 Season

The pre-season forecast suggested an Inside chum return of approximately 2.3 million.

#### Johnstone Strait

In-season management indicated a run size estimate of 2.6 million (November 5). As outlined in the Pacific Salmon Treaty, the harvest rate in Johnstone Strait is limited to 10% for run sizes less than 3.0 million. Test fishing commenced on September 18 and closed in early November. Johnstone Strait Clockwork fisheries for seine, gillnet and troll were conducted between October 1 to 9. The catch results are as follows:

- Seine fishery conducted on October 1, 2001 (24hrs), estimated catch 155,000 chum
- Gillnet fishery conducted on October 4<sup>th</sup> to 6<sup>th</sup> (48hrs), estimated catch 23,000 chum
- Troll fishery conducted on October 8<sup>th</sup> to 10<sup>th</sup> (72hrs), estimated catch of 7,400 chum

The total commercial fishery catches (including 6,500 selective fishery catch) from Johnstone Strait is 192,000. In addition test fishery payment catches and First Nation harvests totaled 30,000 and 14,000 respectively. Based on the above catches and the estimated run size the harvest rate in Johnstone Strait was estimated at less than 10%.

Test fishing in Johnstone Straits continued until early November 2001.

#### Strait of Georgia

Preseason expectations suggested surpluses for Mid-Vancouver Island areas and Saanich Inlet (Goldstream River). In-season management commenced in mid-October. Early fisheries in Mid-Vancouver Island area occurred with gillnet starting October 22-24, 29-31, November 5-11 and 18-23. Gillnet catches totaled approximately 42,000. Troll fisheries occurred on October 22-24, 29-31, November 5-11 and 18-19. Troll catches are estimated to total 1,700. Seine fisheries occurred November 12-14 and 18-19 with catches totaling only a few hundred. Commercial catches for all three gear types totaled 44,000 chum.

A one-day gillnet fishery occurred in Nanaimo area on November 5-6 for a catch of 1,200 chum.

Gillnet fisheries in Area 18 (Cowichan) occurred November 12-16 and 20-21, while a seine fishery occurred November 18-19. Catches were 13,000 and 6,000 for gillnet and seine respectively.

First Nation fishery catches were estimated at 10,000, which do not include special surplus fisheries (ESSR). ESSR fisheries harvested 135,000 in Saanich Inlet and 7,000 at Sliammon (near Powell River BC in Area 15).

#### Fraser River

Chum test fishing at Albion began on September 1 and chum catches to November 6 totaled 10,600 chum. As of November 6 the preliminary run size estimate predicted by

the Bayesian model first used in 2000 was 2.1 million. This was above the pre-season forecast of 1.4 million. First Nation's fisheries to October 28 caught 36,000 chum of which approximately 20,000 were taken in selective fisheries initiatives. A commercial fishery on Oct. 21 harvested 38,500 fish while a second fishery on Nov. 7 harvested 5,000 fish for a total commercial catch of 43,500. No commercial selective fishing experiments were undertaken in 2001.

#### **4. WEST COAST CHUM**

##### **4.1 Conservation and Harvest Management Requirements**

Chum salmon stocks return to most areas on the west coast of Vancouver Island (WCVI). The major stock, and the stock which has implications for the PST, is the Nitinat group of stocks, originating from tributaries to Nitinat Lake (Statistical Area 22) including a major hatchery on the Nitinat River. The net spawning escapement requirement for the Nitinat Lake tributaries totals 175,000, including 150,000 into the Nitinat River and 25,000 into other tributaries. Additional requirements for hatchery and test fishing may total up to 75,000. Therefore, the gross escapement requirement is 250,000 chum. The escapement objective is 250,000 to a maximum of 350,000. The additional 100,000 above the 250,000 target are required for hatchery brood stock requirements and increased distribution of spawners in the Nitinat River.

The management of this fishery is based on achieving the total escapement requirement of 250,000 into Nitinat Lake. Weekly escapement targets are set to ensure that all timing components of the run are represented. Weekly fisheries are scheduled in Area 21 and surrounding waters to harvest any identified surplus. Secondary objectives of the management regime are to achieve stock assessment, harvested fish quality, and allocation requirements.

The fishing plan is based on providing early opportunities for gill net followed by a seine fishery to balance allocation and then a seine/gill net fishery at the peak of the run. Fisheries are dependent on reaching weekly escapement milestone levels into Nitinat Lake. Early season opportunities are constrained by concerns over Thompson River steelhead by-catch.

Gillnet and seine vessels take part in the Nitinat area fishery. A gillnet assessment fishery begins in late September to provide early allocation to gillnets plus information for stock assessment. If weekly escapement targets are achieved and a further surplus is identified, then seines are allowed to fish to a catch equal to that of the gillnets. During these single gear fisheries, the outer fishing boundary is a line between a point two miles due south of Pachena Point and a point two miles south of Bonilla Point. Subsequent fisheries may be open to both gear types, depending on achievement of the weekly escapement targets. During combined gear fisheries, a gillnet only area is provided in Area 20-1 (extending the line two miles offshore eastward). This action is meant to increase the exploitation rate on the Nitinat chum stock and thereby reduce the risk of over-escapement into Nitinat

Lake. Increased exploitation rates result mainly from reduced congestion in the regular area, which increases the efficiency of the seine fleet. Migration of the Nitinat chum stock through the extension area also provides some increased exploitation by gillnets. Safety concerns for smaller gillnet vessels are also a consideration for the extended area. A gillnet test vessel, along with visual surveys of the river, are used to determine escapement into Nitinat Lake. Additional objectives include minimizing the bycatch of chinook, coho, and steelhead.

Since 1995, bycatch concerns have been addressed by delayed opening dates, reduced fishing area, increased use of weed lines, and selective fishing techniques. In 1996 the feasibility of using an outside gillnet test fishery was explored to determine the distribution of steelhead, coho, and chum salmon in Area 21. In 1997, the outside gill net test fishery was implemented with eight vessels fishing one or two 200 fathom chum gill nets, in a predetermined grid pattern to determine the temporal, spatial, and vertical distribution of steelhead, coho, and chum salmon in Area 21. The test fishery continued 7 days/week through October 12. Results from the 1997 outside test fishery resulted in a modified boundary, one nautical mile true south from Pachena Point and the Bonilla Point light to reduce the catch of coho and steelhead. In 1998 the outside gill net fishery continued with 7 vessels each fishing 2 nets in a systematic grid pattern. The area was reduced to avoid passing steelhead, and not implemented until September 21 in order to avoid passing steelhead and coho. This test fishery objective was to determine the relative abundance and geographical distribution of chum and other species.

In 1998, to minimize encounters of passing stocks of coho and Thompson River steelhead, the first commercial gillnet fishery was delayed until October 4. In addition, the initial fishing area was reduced to within a one mile boundary between lines true south from Pachena and Dare Points, based on information from the gillnet test fishery. To reduce mortality of coho and steelhead and to improve catch data, the following measures were implemented for the entire season:

- non-retention of coho and steelhead (seine and gillnet)
- mandatory functional revival tanks (seine and gillnet)
- daylight fishing only (gillnet)
- onboard observers (seine and gillnet)
- logbooks and weekly hail-ins (seine and gillnet)
- mandatory brailing (seine, waived mid-afternoon on October 11)

The outside gillnet test fishery was continued in 1999 with further modification. The area remained the same as in 1998 and fishing was not implemented until September 25 to avoid passing steelhead and coho. This test fishery included 7 vessels each fishing 2 nets in a systematic grid pattern. Each vessel fished one 6 strand Alaska Twist twine net and one multi-strand twine net to test the relative selectivity of each twine type. All nets were hung with a 2-meter weed line to further reduce steelhead bycatch.

## 4.2 Catch, Escapement and Run Size

Catch in Nitinat (Area 21) has traditionally occurred by gillnet and seine (Table 7). Catches for the commercial users generally occur outside the lake, in marine areas. Catch of non West Coast chum in the past has occurred in the outside areas. Management actions have occurred in the past to reduce this catch by restricting harvest closer to the terminal area. Within the lake, catches for special purposes or surpluses to First Nations have occurred more recently. Escapements have varied over the years with a high of 450,000 to a low of 8,000.

Table 7. Nitinat Commercial Catch 1994- 2001.

Year	Seine		Gillnet		Total
	Catch	%	Catch	%	
1994	533,000	64.5%	293,000	35.5%	826,000
1995	30,000	14.4%	179,000	85.6%	209,000
1996	268,000	78.1%	75,000	21.9%	343,000
1997	831,000	79.2%	218,000	20.8%	1,049,000
1998	537,000	77.4%	157,000	22.6%	694,000
1999	12,000	12.4%	85,000	87.6%	97,000
2000	0	0.0%	7,000	100.0%	7,000
2001	89,000		75,000		164,000

Pre-season forecasts are based on escapement, survival of each year class and previous years environmental factor. Fishing may start using pre-season forecasts, but are replaced by inseason information from test fishing, commercial catch and escapement data. Total stock includes catch, escapement and in-lake mortality in some years. The catch is further separated into stocks of origin to provide an estimate of the terminal stock presented in Table 8.

Table 8. Nitinat area escapement, catch, and total stock.

YEAR	AREA 22 Natural Spawners	AREA 21 TOTAL CATCH All stocks	AREA 21 CATCH WCM ONLY	AREA 21 CATCH US	AREA 21 CATCH FR, GS, US	AREA 22 Inlake Catch & Broodstock	Inlake Prespawn Mortality	TOTAL NTINAT STOCK
1980	54,500					279,211		333,711
1981	115,000							115,000
1982	22,500							22,500
1983	7,960							7,960
1984	76,000	186,669	148,962		37,707			224,962
1985	210,000	1,609,364	1,081,422	109,746	527,942			1,291,422
1986	142,820	387,470	297,355	673	90,115	8,000		448,175
1987	50,200	395,397	316,994	8,528	78,403	8,576	150,000	525,770
1988	188,728	1,821,677	1,419,091	31,765	402,586	56,000		1,663,819
1989	116,300	294,660	249,136	5,710	45,524	31,553		396,989
1990	229,000	24,549	8,167	1,171	16,382	71,122		308,289
1991	350,000	494,750	466,599	2,086	28,151	71,000	50,000	937,599
1992	150,000	1,075,735	916,936	50,637	158,799	71,700	5,000	1,143,636
1993	259,000	764,740	642,806	19,130	121,934	216,000		1,117,806
1994	350,000	823,392	666,920	26,668	156,472	175,000		1,348,392
1995	119,319	186,424	149,729	4,815	36,695			305,743
1996	330,000	396,613				207,321		933,934
1997	450,042	1,027,135				253,555		1,730,832
1998	192,253							1,357,966
1999	133,348	129,518	114,443		15,075	89,033		351,899
2000	23,438					10,595		34,033
2001	303,364	130,997				170,000		604,361
Avg (84-97)	198,262	601,131	404,910		114,386	97,650	13,667	830,663
Avg (pre92)	170,381	651,817	498,466		153,351	41,042	25,000	724,628
Avg (92-01)	231,076	503,839	311,354		69,854	149,151	714	892,860

note: average 1992-present describes the period of greater than 20 million releases from Nitinat Hatchery

### 4.3 Annual Detailed Summaries

#### 4.3.1 1994 Season

The pre-season forecast was for a harvestable surplus of approximately 1. million chum. Chum salmon returning to Area 22 (Nitinat Lake) are caught in Area 21 and parts of Area 121 and 20-1.

The season opened with a 4 day gill net fishery commencing September 26, which was extended until the October 7 (11days). Gill nets reopened October 10 for 3 days then closed since early season catch limits had been reached. Seines fished 2 days starting October 15. After the seine fishery, gill nets reopened and fished continuously until the end of the season. Seines reopened October 18 and also fished continuously until the end of the season on November 8.

Until October 18 fishing was limited to waters inside a line 2 nautical miles true south of Pachena Point to 2 nautical miles true south of Bonilla Point. Commencing October 18 gill nets were allowed additional area to fish inside a line as far east as 2 nautical miles true south of Logan Creek.

Gill nets fished for 24 days and caught 270,200 chum. Seines fished 11 days and caught 568,610 chum for a combined total of 838,810 chum. The fishery continued into the second week of November. Escapement into Nitinat Lake reached 500,000 chum and the hatchery reached the egg target of 35 million eggs.

The 1994 WCVI troll catch of chum (Areas 21 to 27, 121 to 127 and 130-1) was 15,800. The troll catch was taken predominantly in the northwest region of WCVI.

#### *4.3.2 1995 Season*

The pre-season forecast was for a harvestable surplus of between 400,000 and 1,100,000. The wide range reflected uncertainty in survival rates for chum salmon from the 1991 brood year, which went to sea in the spring of 1992 (an EI Nino year).

The 1995 season commenced October 2 and gillnets fished 12 days for a total of 144,000 chum salmon. The fishery was closed because of insufficient escapement into Nitinat Lake. Escapement into Nitinat Lake was less than 200,000. There were no seine fisheries in 1995, except for test fisheries. The hatchery collected 28 million chum eggs; 7 million eggs short of the 35 million target.

#### *4.3.3 1996 Season*

The pre-season forecast was for a harvestable surplus of less than 100,000 based on ocean conditions associated with EI Nino adversely affecting survival from the 1992 brood year, and to a lesser extent the 1993 brood year.

Test fishing in Nitinat Lake found no build-up until October 5 when 130,000 were estimated. Subsequently, a gillnet fishery was held on October 9-10. One hundred boats participated for a catch of 19,500 chum. Test fishing in Nitinat Lake during the next week indicated that fish were moving in and out of the lake. By October 15 there were 210,000 chum in both Nitinat Lake and Nitinat River and a gillnet opening occurred on October 19-20. The area was opened to troll at the same time to test the viability of a selective troll fishery for chum and to help balance catches between gears for the season. No trollers chose to participate. On October 17 the estimate in Nitinat Lake had risen to 270,000 and a seine opening occurred on October 22-23. Gillnets fished on October 24-25 and then both gear-types fished together from October 25 until the fishery closed on November 8. The total Nitinat chum catch, was 359,000 (292,000 by seine and 67,000 by gillnet) and total chum escapement to Nitinat Lake including hatchery broodstock was estimated at 280,000.

#### 4.3.4 1997 Season

In 1997, the pre-season forecast was for a harvestable surplus of approximately 1.0 million chum salmon, based on good escapements in the brood years, high hatchery production levels in the brood years, below average ocean survival for the 1993 brood year and average survival for the 1994 brood year.

The in-lake gillnet test fishery for chum salmon began September 24 to assess escapement level. The outside seine test vessels started October 2 and continued to October 29 in Statistical Areas 21 to 26 inclusive.

Due to low chum catches in the outside gill net test fishery, commercial openings at Nitinat were delayed until October 6. Gill nets then fished for 2 weeks (3 days each week) with good catches. Between October 16-20, escapement increased rapidly to 400,000, exceeding the weekly and seasonal goals. Seining opened October 20 in the normal two mile boundary for one day with a second day extension. A total of 576,000 chum were caught in this opening. Gillnets opened the next day until further notice, with seines open until further notice on the following day. When both seines and gillnets fished at the same time, a gill net only area from Bonilla Point light to Logan Creek with a 2 nautical mile offshore boundary was open. The fishery ran continuously except for several days when the weather was too rough. Effort tapered off until the fishery was closed on November 12. Total Nitinat chum catch, was 1,069,000 (860,000 by seine and 209,000 by gillnet) and total chum escapement to Nitinat Lake including hatchery broodstock was estimated at 600,000.

A directed chum troll fishery off the WCVI was open from October 2 to October 24, in Areas 21, 121-127, parts of Area 25, and Area 12. However there was no effort or catch in the vicinity of Nitinat. The total WCVI troll catch of chum was 3,200 based on fish slips.

#### 4.3.5 1998 Season

In 1998, the pre-season forecast was for a harvestable surplus of 1.0 million chum salmon.

The fishery was open to gillnets through October 10, when it closed for two days to allow a seine fishing opportunity. Gillnets re-opened on the morning of October 13 until further notice with the area expanded easterly to a line true south of Carmanah Point. On October 20 the area was further expanded to a line true south of Logan Creek to address safety and economic concerns. The fleet size remained small and fishing closed on November.

The seine fishery opened within a one mile boundary between lines true south of Pachena and Carmanah Points on October 11.

Observer information indicated a low incidence of coho. On October 20 the fishing area was expanded easterly to a line true south of Bonilla Point. Seine openings continued through November 8, although no seines fished after October 29. Total commercial catch was 832,000 including 152,000 by gillnet and 647,000 by seine plus 20,000 by gillnet test fisheries and 13,000 by seine test fisheries. Escapement to Nitinat River was 179,000 chum.

#### *4.3.6 1999 Season*

In 1999, the preseason forecast suggested a harvestable surplus of 700,000 chum salmon based on good escapements in 1994 and 1996 and poor escapement in 1995. The hatchery fry output was 31 million, 25 million, and 32 million, respectively for the 1994, 1995, and 1996 brood years.

To minimize encounters of passing stocks of coho and Thompson River steelhead, the first commercial gillnet fishery was delayed until October 4. The fishery was opened to gillnets from October 4 through October 20 (initial 2 day opening with a series of 2 to 3 day extensions). There was no seine fishery, as escapement milestones were not met. Observer information indicated a low incidence of by catch of non-target species throughout the fishery.

The total commercial gillnet catch was 109,000 plus 9,000 by gillnet test fisheries and 11,000 by seine test fisheries. The total chum salmon escapement into Nitinat Lake (Area 22) was 200,000 including 100,000 natural spawners and 100,000 taken for broodstock, First Nation catch and test fishing. Also 5,000 chum were lost during a lake turnover. The hatchery egg take was 35 million.

#### *4.3.7 2000 Season*

No commercial fisheries occurred in 2000 because of the extremely low migration rate into Nitinat Lake resulting in a total escapement of 30,000 which was far less than the escapement objective of 250,000.

#### *4.3.8 2001 Season*

Preseason expectations for this system were forecast at 210,000 chum. The overall gross escapement required into Nitinat Lake is 250,000.

Test fishing commenced with gillnets outside Nitinat Lake on September 17th. Further information of testing outside (gillnet and seine), in-lake gillnet testing and escapements to Nitinat River, suggested a run size larger than expected. A commercial gillnet fishery commenced on October 15 for 2 days. The resulting catches were favourable and continued assessments resulted in confirmation of gross escapement goal being met. Further fishing was initiated for gillnets (October 19 and 20) and seines for October 21. The fisheries continued for both seine and gillnet on October 22 and closed November 4. The total commercial catch was 54,000 and 72,000 chum for gillnet and seine, respectively. The Nitinat system spawning estimate was approximately 300,000 chum.



## 5. UNITED STATES STOCKS AND FISHERIES

### 5.1 Washington Run Sizes, Catches, and Spawning Escapements

Tables 9-11 provide the pre-season forecasts of run size, and post-season estimates of spawning escapement and total run size for the various chum salmon runs returning to Puget Sound and Coastal Washington areas. The tables break the estimates down by three major groupings associated with return timings (summer, fall and winter chum) that are forecast and managed separately.

Table 9. Washington Summer Chum Salmon Pre-Season and Post-Season Estimates of Abundance and Estimated Spawning Escapements (1994 to 2001).

Region		1994	1995	1996	1997	1998	1999	2000	2001
Strait of Juan de Fuca	Pre-Season	532*	474*	2,440	1,626	775	871	792	941
	Post-Season	182	840	1,085	963	1,261	521	923	3,091
	Escapement	182	839	1,084	962	1,260	521	923	3,075
South Puget Sound	Pre-Season	52,303	29,230	79,551	69,634	149,950	121,039	84,867	75,599
	Post-Season	63,830	63,700	125,072	16,697	87,504	23,545	39,028	84,111
	Escapement	54,391	55,179	114,316	16,001	80,404	23,461	27,705	62,821
Hood Canal	Pre-Season	1,586*	2,942*	7,212	11,126	10,856	6,742	6,988	6,871
	Post-Season	2,445	9,478	20,516	9,171	4,370	4,058	9,328	12,002
	Escapement	2,443	9,469	20,505	9,077	3,951	4,057	8,581	11,816

\* Washington run sizes only

Table 10. Washington Fall Chum Salmon Pre-Season and Post-Season Estimates of Abundance and Estimated Spawning Escapements (1994 to 2001).

Region		1994	1995	1996	1997	1998	1999	2000	2001
Willapa Bay	Pre-Season	32,200	53,400	42,116	25,500	35,000	78,010	69,188	53,958
	Post-Season	35,310	27,617	22,499	34,112	76,714	25,630	46,991	53,958
	Escapement	30,526	24,695	20,011	33,286	65,092	24,512	40,030	53,535
Grays Harbor	Pre-Season	20,344	46,988	36,098	27,138	13,370	46,400	32,000	21,182
	Post-Season	25,287	20,816	16,881	14,071	37,161	15,198	10,432	26,049
	Escapement	24,592	12,612	12,413	13,456	35,188	12,260	8,942	24,898
Strait of Juan de Fuca	Pre-Season	4,546	4,879	19,319	14,295	3,130	1,519	3,129	2,234
	Post-Season	2,564	610	2,162	3,927	1,535	1,313	269	1,737
	Escapement	2,491	566	2,121	3,780	1,419	1,272	219	1,562
Nooksack/Samish	Pre-Season	156,206	107,800	154,200	51,122	82,000	25,378	95,598	95,598
	Post-Season	197,300	88,000	69,900	55,000	149,600	94,000	18,878	131,412
	Escapement	103,804	41,300	51,889	22,222	89,206	34,594	5,244	75,919
Skagit	Pre-Season	178,766	84,000	224,300	48,858	188,600	43,350	47,157	47,157
	Post-Season	294,300	69,500	118,000	17,100	146,800	47,800	188,878	131,412
	Escapement	122,290	38,667	74,990	14,552	121,475	34,936	22,377	63,457
Stillaguamish/Snohomish	Pre-Season	290,663	154,186	234,598	58,175	338,331	151,012	113,834	113,834
	Post-Season	391,600	111,400	213,800	28,500	352,800	123,100	56,093	361,347
	Escapement	244,482	55,336	152,239	20,066	243,991	91,091	39,050	85,119
South Puget Sound	Pre-Season	487,501	311,900	681,600	365,299	1,143,700	665,566	396,302	396,302
	Post-Season	557,600	442,000	634,600	130,700	682,700	234,500	234,976	940,776
	Escapement	286,414	243,818	360,255	85,951	430,589	163,403	105,857	313,570
Hood Canal	Pre-Season	459,018	723,187	705,500	583,380	662,659	176,811	353,949	353,949
	Post-Season	961,800	606,000	821,100	456,000	575,300	147,300	153,346	793,359
	Escapement	382,213	217,199	409,523	125,302	244,354	87,095	62,931	255,371

Table 11. Washington Winter Chum Salmon Pre-Season and Post-Season Estimates of Abundance and Estimated Spawning Escapements (1994 to 2001).

Region		1994	1995	1996	1997	1998	1999	2000	2001
South Puget Sound	Pre-Season	80,018	43,647	48,875	82,900	36,748	51,973	33,568	54,631
	Post-Season	104,174	47,202	29,862	13,099	77,885	17,579	11,323	158,380
	Escapement	76,072	26,233	24,103	9,271	76,676	15,691	8,524	139,046

Table 12 provides chum catch information from the Strait of Juan de Fuca fisheries (areas 4B,5,6C) and the San Juan Islands/Point Roberts fisheries (areas 6,7,7A), and for all other Puget Sound and Washington Coastal areas combined into regional aggregates.

Table 12. Chum Catch From Puget Sound and Washington Coastal Areas

Region	User Group	1994	1995	1996	1997	1998	1999	2000	2001
4B,5,6C	Treaty	55735	21193	33338	30802	18577	7190	5621	10209
	Non-Treaty	0	0	0	0	0	0	0	0
6,7,7A	Treaty	25340	19794	85	62	34559	79	31	0
	Non-Treaty	46987	27577	5	186	6380	0	402	3247
Puget Sound <sup>1</sup>	Treaty	687371	333859	217887	156236	253716	102831	126785	639945
	Non-Treaty	514256	345346	530367	229075	498969	133404	139218	840898
Coast <sup>2</sup>	Treaty	36515	13152	16597	3061	20184	11284	16473	2910
	Non-Treaty	654	4891	2215	45	9727	1268	6860	23556
Total	Treaty	804961	387998	267907	190161	327036	121384	148910	653068
	Non-Treaty	561897	377814	532587	229306	515076	134672	146480	867697

<sup>1</sup>All other Puget Sound Freshwater and marine catch reporting areas except SJF and San Juan Islands fisheries.

<sup>2</sup>Coastal areas combine catch and reporting areas 1-4 including Grays Harbor, Willapa Bay and Columbia River.

Paragraph 10 of the Chum Annex requires the Canada and the United States to assess catch levels of summer chum salmon caught during the August 1 through September 15 time period in boundary area fisheries. Table 13 provides weekly chum catch during the summer chum management period for U.S. boundary area fisheries.

Table 13. Commercial Chum Catch in the Strait of Juan de Fuca and the San Juan Islands During the Summer Chum Management Period.

7-Day Periods:	--->8/11	8/12-8/18	8/19-8/25	8/26-9/1	9/2-9/8	9/9-9/15	
Week #:	32 <sup>1</sup>	33	34	35	36	37	Total
95-97 GSI <sup>2</sup>	0.68	0.68	0.40	0.45	0.14	0.07	
1994	23	15	66	5	0	0	109
1995	60	1	26	9	40	0	136
1996	24	65	4	0	0	0	93
1997	41	4	7	0	7	54	113
1998	44	16	1	0	0	0	61
1999	7	0	0	0	0	0	7
2000	11	2	0	0	0	0	13
2001	29	0	0	0	0	0	29

<sup>1</sup> Indicates cumulative catch through this week.

<sup>2</sup> Percentage of HC/SJF summer chum from GSI samples.

## **5.2 U. S. Strait of Juan de Fuca Fisheries (Areas 4B, 5, 6C)**

### *5.2.1 Management Intent*

Throughout the period from 1994 to 2001, the management strategy for the Strait of Juan de Fuca fishery has consisted of limiting the total effort in this fishery and keying management decisions on the needs of Puget Sound stocks of chum salmon. The limited effort nature of this fishery is maintained by limiting access to only four treaty Indian tribes using only gillnet gear.

This fishery has been constrained on the opening date until mid-October due to conservation concerns for coho salmon for all of the years reported except 2001. This, coupled with lower catch rates, low market prices, and often poor weather conditions, has resulted in relatively modest catch levels, which have had a pronounced decreasing trend over the period of 1994 to 2001 (Table 12). This coupled with GSI information collected through 1996 indicates a decreasing level of interceptions of Canadian origin stocks.

### *5.2.2 1994 Season*

Fall chum fishing in 1994 was delayed until the week of October 16 due to domestic coho conservation concerns. Test fisheries were conducted during the two weeks prior to the commercial fishery opening to collect GSI samples and assess species composition. The commercial fishery was initially opened for five days from noon on October 16 to noon on October 21. It reopened at noon on October 23 and remained open continuously until November 2. The fishery was closed for 24 hours in order to permit catch assessment, and was reopened at noon on November 3 for two additional days, closing at noon on November 5. There was one additional opening the following week from 8 AM on November 9 to 6 PM on November 11.

Incidental summer chum catches in fisheries prior to September 16 totaled only 88 fish. Fall chum catches in the Strait of Juan de Fuca commercial fishery were somewhat lower than expected given the forecasted abundance of Puget Sound and Canadian chum runs. The total chum catch in areas 4B, 5, 6C, reported for 1994 was 55,735.

### *5.2.3 1995 Season*

The Strait fishery in 1995 was delayed until the week of October 15 due to domestic coho conservation concerns. Test fisheries were conducted during the two weeks before the commercial fishery opening to collect GSI samples and assess species composition. The commercial fishery was initially opened for five days from noon on October 15 to noon on October 20. Due to very low catches, the fishery was extended, prior to closing on October 20, and remained open continuously until November 11.

Incidental summer chum catches in fisheries prior to September 16 totaled only 75 fish. Fall chum catches in the Strait of Juan de Fuca commercial fishery were considerably less than expected given the forecasted abundance of Puget Sound and Canadian chum runs. The total chum harvest for the season was 21,193 chum.

#### *5.2.4 1996 Season*

The 1996 chum fishery in the Strait of Juan de Fuca was delayed until the week of October 13 due to domestic coho conservation concerns. Test fisheries were conducted during the week of 10/6 prior to the commercial fishery opening to collect GSI samples and assess species composition. The commercial fishery was initially opened for five days from noon on October 13 to noon on October 18. However, the incidental catch of coho salmon was very low and the fishery was extended prior to closing on October 18. The fishery remained open continuously until November 15 when it was closed for the season.

Incidental summer chum catches in sockeye salmon fisheries, prior to September 16, totaled only 93 fish. There were an additional 660 chum harvested in test fisheries for GSI collection. Fall chum catches in the Strait of Juan de Fuca commercial fishery were significantly lower than expected given the forecasted abundance of Puget Sound and Canadian chum runs. The total chum catch reported from areas 4B, 5, 6C in 1996 was 33,338 fish.

#### *5.2.5 1997 Season*

Chum fishing in 1997 was again delayed until the week of October 12 due to domestic coho conservation concerns. The commercial fishery began October 15 and remained open 7 days per week until November 15. No test fisheries for collection of GSI samples were conducted, and no samples for GSI analysis were collected from the commercial catch during 1997.

Incidental summer chum catches in fisheries prior to September 16 totaled only 16 fish. Fall chum catches in the Strait of Juan de Fuca commercial fishery were significantly lower than expected given the forecasted abundance of Puget Sound and Canadian chum runs. The total chum catch reported from areas 4B, 5, 6C, in 1997 was 30,802 fish.

#### *5.2.6 1998 Season*

The 1998 chum fishery again was delayed until the week of October 11. The commercial fishery began October 15 and remained open 7 days per week until November 14. No test fisheries for collection of GSI samples were conducted, and no samples for GSI analysis were collected from the commercial catch during 1998.

Incidental summer chum catches in fisheries prior to September 16 totaled only 55 fish. Fall chum catches in the Strait of Juan de Fuca commercial fishery were significantly less than expected given the forecasted abundance of Puget Sound and Canadian chum runs. The lower than expected harvests were primarily due to very low prices resulting in low effort. The total chum catch reported for areas 4B, 5, 6C, in 1998 was 18,577 fish.

#### *5.2.7 1999 Season*

The 1999 commercial chum fishery began October 15 and remained open 7 days per week until November 13. No test fisheries for collection of GSI samples were conducted, and no samples for GSI analysis were collected from the commercial catch during 1999.

Incidental summer chum catches in fisheries prior to September 16 totaled only 7 fish. Fall chum catches in the Strait of Juan de Fuca commercial fishery were significantly lower than expected given the forecasted chum abundance. The lower than expected harvests were primarily due to low catch rates and low effort. The total chum catch reported in areas 4B, 5, 6C, for 1999 was 7,190 fish.

#### *5.2.8 2000 Season*

In 2000 the commercial chum fishery began October 15 and remained open 7 days per week until November 11. No test fisheries for collection of GSI samples were conducted, and no samples for GSI analysis were collected from the commercial catch.

Incidental summer chum catches in fisheries prior to September 16 totaled only 6 fish. Again, commercial harvests were lower than expected due to low catch rates and low effort. The total chum catch reported for areas 4B, 5, 6C, in 2000 was only 5,621 fish.

#### *5.2.9 2001 Season*

The commercial chum fishery began the week of October 7 and remained open 5 days per week until October 26, when the fishery was expanded to 7 days per week. The Strait of Juan de Fuca chum fishery was closed for the season on November 9. No test fisheries for collection of GSI samples were conducted, and no samples for GSI analysis were collected from the commercial catch during 2001.

Incidental catches of summer chum salmon occurring in fisheries prior to September 16 were only 21 fish. There were also some chum salmon harvested prior to the fall chum management in fisheries directed at coho salmon. Effort in the chum fishery was again quite limited due to low prices and poor weather conditions. The total chum catch reported in areas 4B, 5, 6C for 2001 is 10,209.

### **5.3 U. S. San Juan Islands/Point Roberts Fisheries (Areas 7 And 7A)**

#### *5.3.1 Management Intent*

The U.S. fishery in areas 7 and 7A is managed pursuant to paragraph 3 of the Chum Annex. This provision is intended to link this fishery to the Canadian Clockwork management strategy employed in Johnstone Strait. For the years 1994 through 1998, the chum annex provided for a U.S. harvest in areas 7 and 7A of no more than 20,000 chum when the Johnstone Strait run size was less than 3.0 million, and the catch in Johnstone Strait was less than 225,000 chum. It also provided for a U.S. harvest in areas 7 and 7A of 120,000 chum when the run size exceeded 3.0 million and the catch in Johnstone Strait was greater than 225,000 chum, and provided for a U.S. harvest in areas 7 and 7A of 140,000 chum when the run size exceeded 3.7 million and the catch in Johnstone Strait

was greater than 640,000 chum. In 1999, the Chum Annex was renegotiated to reflect a number of changes including an update in the threshold for the second fishing level from a catch in Johnstone Strait if 225,000 to 280,000, and a change in the threshold for the third fishing level from a Johnstone Strait run size of 3.7 million to a run size of 3.9 million, and a Johnstone Strait catch level from 640,000 to 745,000 chum. These changes were made to bring the annex up to date with changes in the Clockwork management scheme that were implemented by Canada in 1992.

Paragraph 3 of the Chum Annex also provides for the U.S. to manage its fishery to maintain a traditional proportion of the catch between areas 7 and 7A and to avoid concentrations of effort along the international boundary in area 7A. Table 14 provides a summary of the catch by area for the years 1994 through 2001. There have been only three years with a significant fishery during this time period and the percentage of the catch in area 7A ranged from 23.8% to 61.5%. Historically, the catch had been distributed approximately 50/50 between the two areas.

Table 14. Distribution of Catch Between Areas 7 and 7A.

Catch Area	1994	1995	1996	1997	1998	1999	2000	2001
7	27,491	31,552	1	97	30,913	0	430	1,006
7A	43,856	15,813	89	151	9,634	79	2	2,241
% in 7A	61.5%	33.4%	*	*	23.8%	*	*	*

\* Non-fishing years; primarily incidental catches.

Paragraph 5 of the Chum Annex to the PST provides a “make-up” and “pay-back” provision should the U.S. fishery in areas 7 and 7A fail to achieve the catch levels specified in paragraph 3. Table 15 provides a summary of the differences between the specified catch levels in this fishery for the years 1991 through 2001 and the actual catches achieved, and provides a cumulative summary of any “make-ups” or “pay-backs” due.

Table 15. Summary of U.S. Areas 7 and 7A allocations and catches, 1991-2000.

YEAR	PST SPECIFIED CATCH LEVEL	ADJUSTED CATCH QUOTA	ACTUAL CATCH	CURRENT DUE U.S.
1991	120,000	120,000	138,361	- 18,361
1992	140,000	121,639	119,210	2,429
1993	140,000	142,429	139,861	2,568
1994	*	*	72,327	*
1995	120,000	122,568	47,371	75,197
1996	20,000	20,000	90	75,197
1997	20,000	20,000	248	75,197
1998	140,000	215,197	40,939	174,258
1999	20,000	20,000	79	174,258
2000	20,000	20,000	433	174,258
2001	20,000	20,000	3,247	174,258

\* - No annex in place in 1994.

### *5.3.2 1994 Season*

In 1994, relatively few summer chum (21 fish) were harvested incidental to fisheries targeting on other species (sockeye). The Johnstone Strait chum run size was updated in-season to 4.6 million. Due to concerns for the status of natural coho stocks returning to Puget Sound, the bulk of the fishery in areas 7/7A was delayed until the end of October. Although there was no chum annex in place for 1994, it was the intent of the U.S. managers to manage the fishery consistent with previous chum annex agreements. Given these limitations, the U.S. scheduled a limited, reef net only, fishery beginning October 2 with a requirement to release all chinook, coho and sockeye. The reef net fishery was open continuously through November 5.

Test fisheries to collect chum GSI samples were conducted in area 7A the week of October 23. Indications were that very few coho remained in the area and a Treaty Indian fishery was opened from Noon on October 28 until 9 PM on October 29. A Non-treaty fishery followed the Treaty Indian fishery, opening on October 31 for gillnets from 4:00 PM to 8:00 AM; and November 1 for purse seines from 6:00 AM to 7:00 PM. The fishery, originally scheduled for two days, was extended for an additional two days (through November 4) due to low effort and poor catches.

An additional four day non-treaty fishery was conducted from November 7 through November 10. For the weeks of November 13 and November 20, additional non-treaty fisheries were scheduled for four days and three days, respectively. Total 1994 chum catch reported from areas 7/7A is 72,327 fish.

### *5.3.3 1995 Season*

In 1995, 61 summer chum were harvested incidental to fisheries targeting other species (sockeye and pink salmon), prior to September 16. Preseason forecasts were for strong fall chum returns to both southern B.C. and Puget Sound. In-season test fishing results from both B.C. and Washington fisheries remained quite variable throughout the season resulting in uncertainty about run size estimates. It wasn't until October 27 that DFO staff notified U.S. managers that the Johnstone Strait run size was updated to 3 million and fisheries were scheduled by Canada to harvest at the 20% level. At this abundance level, the Chum Annex of the PST provided for a U.S. quota of 120,000 chum to be taken in areas 7 and 7A, plus an add-on for the shortfall of 2,568 from the 1993 season, for a total target of 122,568. Given this information, the U.S. managers immediately opened fisheries in areas 7 and 7A. Due to the late timing of the run size update and the openings, as well as the poor catches in the test and reef net fisheries in U.S. waters, very low catches were expected.

Given the low abundance forecast from the early in-season updates, the first chum fishery in areas 7 and 7A was a reef net fishery designed to remain well within the 20,000 catch limit provided in the Annex for run sizes below 3.0 million and Johnstone Strait catches of less than 225,000 chum. Reef net fishing began on October 1 and was open continuously until October 21, with a limitation of retaining only chum salmon.



Test fisheries to collect chum GSI samples were conducted in area 7A the weeks of October 8, October 15 and October 22. However due to poor catches only partial samples were obtained.

The first Treaty Indian commercial fishery was for 36 hours beginning on October 29 and closing on October 30. A non-Indian commercial fishery followed the Treaty Indian fishery, opening on November 2<sup>nd</sup> and 3<sup>rd</sup> from 6:00AM to 6:00PM for both gillnets and purse seines. Another Treaty Indian opening followed immediately after the Non-Indian fishery for two and a half days, from November 4 through November 6.

Following these openings, the fishery was open continuously for either treaty Indian or Non-Indian fisheries, or both simultaneously (11/13 – 11/17). Due to poor catch levels the effort from the latter two weeks of the fishery was extremely low. The fishery closed for the season on November 17. Total chum catch reported from areas 7 and 7A for 1995 is 47,371.

#### *5.3.4 1996 Season*

In 1996, preseason forecasts were for strong fall chum returns to both Southern B.C. and Puget Sound. In-season updates of abundance from Southern B.C. and many areas in Puget Sound were substantially less than expected. In many areas the in-season run size estimates were only about half of the preseason forecasts. The Johnstone Strait chum run size was originally updated in-season to only 1.9 million from a preseason forecast of approximately 4 million.

By early November, CDFO reported that continued test fishing in Johnstone Strait still only indicated a run size of 2.7 million chum, and there were no plans to schedule any additional fishing in Johnstone Strait. This run size estimate was below the levels that would allow increasing the harvest rate beyond 10%, and the total catch level remained below the 225,000 chum threshold which would trigger any significant chum fishery in U.S. catch areas 7 and 7A. Pursuant to the Chum Annex of the PST, the U.S. fishery in Areas 7 and 7A was not to harvest more than 20,000 chum. No chum fisheries were opened in these areas in 1996, and only a few chum were harvested incidentally in fisheries for sockeye. Test fisheries to collect chum GSI samples were not conducted in 1996. The total chum catch reported from these areas in 1996 was only 90 fish.

#### *5.3.5 1997 Season*

In 1997, preseason forecasts were for strong fall chum returns to both Southern B.C. and Puget Sound. In-season updates of abundance from Southern B.C. and many areas in Puget Sound were substantially lower than expected. In many areas the in-season run size estimates were again only about half of the preseason forecasts. The Johnstone Strait chum run size was updated in-season to only 2.5 million from a preseason forecast of approximately 5 million.

Due to the low run size estimate for the Canadian inside chum runs, the U.S. managers did not open any commercial chum fisheries in catch areas 7 and 7A in 1997. Only 248 chum salmon were harvested, primarily incidental in fisheries for sockeye and pink salmon prior

to the chum management period. No test fisheries were conducted to collect chum GSI samples in 1997.

#### *5.3.6 1998 Season*

In 1998, preseason forecasts were for harvestable fall chum returns to both Southern B.C. and Puget Sound. The preseason forecast for the run returning to Johnstone Strait was 3.7 million chum. Test fishing in Johnstone Strait in early October indicated a strong chum return, likely exceeding the preseason forecast. On October 9, DFO notified Washington fisheries managers that the run size had been updated to 5.1 million chum and that purse seine fisheries were scheduled to begin in Johnstone Strait on October 12. The Johnstone Strait run size was later updated to 5.5 million chum.

The chum annex provides for a U.S. harvest in Areas 7 and 7A of 120,000 chum when the Johnstone Strait run size is greater than 3.0 million, and the catch in Johnstone Strait exceeds 225,000 chum; and for a U.S. harvest of 140,000 chum when the Johnstone Strait run size is greater than 3.7 million, and the catch in Johnstone Strait exceeds 640,000 chum. Based on the updated run size of 5.1 million and expected harvests in Johnstone Strait, the U.S. harvest quota in areas 7 and 7A was 140,000 chum, plus a carry-over from the 1995 season of approximately 75,000 chum.

Incidental catches of summer chum in sockeye fisheries prior to September 16 totaled only 9 fish.

Gill net and purse seine fisheries in Areas 7 and 7A began on October 14 with a two day treaty Indian fishery. Due to low prices and effort the harvest was lower than expected. Additional treaty Indian fishing was scheduled the following week for approximately 3.5 days (10/19 - 10/22). Treaty fishing was re-opened for periods of 3.5 days, 7 days and 4.5 days for weeks of 10/25, 11/1 and 11/8, respectively. Effort was sporadic over these openings.

Non-treaty fisheries were delayed until November 1 in order to implement domestic agreements to protect coho salmon. Non-treaty fisheries occurred for 4 days the week of 11/2 and 4 days the week of 11/8. Effort in the non-treaty fisheries was also extremely low. The combined treaty and non-treaty harvest in 1998 was 40,939 chum. Test fisheries to collect chum GSI samples were not conducted and no GSI samples were taken from the commercial fishery in 1998.

#### *5.3.7 1999 Season*

In 1999, preseason forecasts were for significant numbers of harvestable fall chum returning to Puget Sound. In contrast, the preseason forecast for the Canadian chum run returning to Johnstone Strait was for only 2.5 million chum, which is less than the 3.0 million required for any significant commercial fishery. Test fishing in Johnstone Strait in early October indicated a somewhat stronger chum return, but still insufficient to allow a fishery. At the conclusion of the test fishery in Johnstone Strait the final in-season run size update was 2.7 million chum.

Based on updated run sizes that remained below 3.0 million, there was no chum fishing conducted in areas 7 and 7A in 1999, and the total reported catch is only 79 chum salmon.

#### *5.3.8 2000 Season*

In 2000, preseason forecasts indicated significant numbers of harvestable fall chum returning to Puget Sound. In contrast, the preseason forecast for the Canadian chum run returning to Johnstone Strait was for only 2.1 million chum, which is less than the 3.0 million required for any significant commercial fishery. Initial test fishing results in Johnstone Strait and some limited commercial fisheries in early October indicated a chum return similar to the forecast, but subsequent test fishing dropped off precipitously and by late October the run was projected at a level considerably lower than 2.0 million.

Based on updated run sizes that remained below 3.0 million, there was only limited chum fishing conducted in areas 7 and 7A in 2000. A non-treaty reef net fishery was opened in mid-September, but did not allow the retention of chum salmon until October 1, in order to protect summer chum salmon. That fishery remained open until November 11, but fishing was poor during the chum management period and very little chum catch occurred after mid-October. The total chum catch in 2000 was only 433 fish.

#### *5.3.9 2001 Season*

Preseason forecasts called for a limited number of harvestable fall chum returning to Puget Sound, however in-season updates of abundance indicated that runs were significantly stronger than anticipated. The preseason forecast for the Canadian chum run returning to Johnstone Strait was for 2.3 million chum salmon, which is less than the 3.0 million required for any significant commercial fishery. Limited commercial fisheries in early October, and test fishing results from mid-September through early November, indicated a chum return somewhat larger than the preseason forecast. The Johnstone Strait run size estimate was updated in-season to 2.6 million.

Based on updated run sizes that remained below 3.0 million, there was only limited chum fishing conducted in areas 7 and 7A in 2001. There were no summer chum salmon reported caught in these areas prior to September 16. A non-treaty reef net fishery was opened in late-September, but did not allow the retention of chum salmon until October 1, to avoid capture of summer chum salmon. That fishery remained open until November 10, but fishing was poor during the chum management period and no chum catch occurred after mid-October. The total chum catch by reef nets was 3,247 fish.

## 6. STOCK IDENTIFICATION

### 6.1 Genetic Stock Identification

#### Canada

Canada conducted sampling for GSI in 1996, 1998, 2000 and 2001. The majority of the GSI work concentrated on sampling commercial (Statistical Area 12 and 13) and/or test fishery (Statistical Area 12) catches in Johnstone Strait.

Uncorrected results were used to estimate US stocks contribution to the WCVI fishery.

In 1996, a total of 1,795 GSI samples were collected in Johnstone Strait between September 17 and November 1.

Two GSI collections were undertaken in Johnstone Strait in 1998. A GSI sample was collected for stock identification from the Johnstone Strait commercial fishery on Oct 2, 2000. On October 1, 2001 a GSI sample was collected from the seine fishery which occurred in Johnstone Strait. A summary of chum GSI sampling is presented in Table 16.

Table 16. Number of chum salmon sampled for GSI data, 1994-2001.

Year	Commercial Samples			Test Fishery Samples		
	Johnstone Strait	Qualicum	Nitinat	Johnstone Strait	Qualicum	Nitinat
1994	0	0	0	0	0	0
1995	0	0	0	0	0	0
1996	0	0	0	1,795	0	0
1997	0	0	0	0	0	0
1998	150	0	0	150	0	0
1999	0	0	0	0	0	0
2000	300	0	0	0	0	0
2001	300	0	0	0	0	0

#### United States

In the U.S., samples for genetic stock identification were collected from various Washington fisheries from the years 1994 through 1998. Samples were collected in area 7 in 1995; in area 7A in 1994 and 1995; in area 5 from 1994 through 1996; in areas 8 and 8A from 1994 through 1998; in area 8D from 1995 through 1998; in area 10 from 1994 through 1998; and in area 12/12B from 1994 through 1998. The U.S. also collected samples from commercial landings from Canadian area 20 from 1995 through 1997.

Table 17 provides a summary of the samples collected in U.S. areas 5, 7, and 7A, and in Canadian area 20. Fisheries in these catch reporting areas are of particular interest under the Chum Annex of the PST.

Table 17. Summary of Chum GSI Samples Taken from U.S. Areas 5, 7 and 7A, and Canadian Area 20.

AREA	YEAR	NO. FISH SAMPLED	NO. FISH ANALYZED	FISHERY TYPE
5	1994	332	326	Test
5	1994	589	589	Commercial
5	1995	244	203	Test
5	1995	631	631	Commercial
5	1996	389	389	Test
5	1996	510	510	Commercial
7	1995	401	400	Commercial
7A	1994	400	0	Test
7A	1994	400	0	Commercial
7A	1995	539	539	Test
7A	1995	534	534	Commercial
20	1995	224	221	Commercial
20	1996	100	98	Commercial
20	1997	80	80	Commercial

## 6.2 Adult Tagging

### Canada

Chum salmon tagging programs occurred in Johnstone Strait during the 2000 and 2001 chum season. The objective of the programs was to evaluate the purse seine fleet fishing efficiency as an important part of the Clockwork review. The fleet efficiency has changed (less vessels) significantly in the last 20 years. While we have qualitative measures of the fleet efficiency, specific indicators of catch efficiency relative to run size are not certain. The chum tagging program was to provide valuable harvest rate and migration timing information. The tagging operations during both 2000 and 2001 were virtually identical. Approximately 4000 fish were tagged during both years, of which roughly 1000 were double tagged to allow for an estimation of tag loss. Recovery method varied between 2000 and 2001. In 2000 the program primarily relied on purse seine crew and fish plant workers to recover tags. A rewards-incentive program drove this program. During 2001 the sampling effort was focused mainly in the fish processing plants. Specifically, there was intensive sampling coverage in the fish plants, which received the majority of the catch.

## 6.3 Coded Wire Tagging , Otolith Marking, Fin Clipping

### Canada

Thermal marking has been used as a technique of mass marking hatchery raised salmonids in B.C. since 1992. The method involves manipulating the temperature of the rearing

water by at least 2°C to induce a mark on the otolith. The change in water temperature can be accomplished through the use of two different water sources, through heating the water or by chilling it. By altering the water temperatures over a period of time a unique mark can be created.

Thermal marking was first used on chum from Nitinat hatchery in 1993 and continues to be used as a means of estimating hatchery contribution to both fisheries and escapement (Table 18). Thermal marking is currently the only method of marking being applied to chum from Nitinat hatchery (following the termination of the Multiple Fin Clip program) and will therefore require more detailed analysis in future. Transplanting of thermally marked chum into Klanawa River began from the 2001 brood year in an attempt to help re-establish that stock.

The Conuma hatchery first began thermal marking several stocks with the 1998 brood year. 2003 will be the first return year for which all hatchery fish will be thermally marked and will require further analysis. A comprehensive sampling program during the fall chum fisheries would permit a better understanding of timing and location of the different stocks within Nootka Sound. It would also allow assessment of the strength of the hatchery and wild stocks.

Table 18. Thermal Marks applied to southern BC chum

Hatchery Facility:	Nitinat	Nitinat	Conuma	Conuma	Conuma	Conuma	Conuma	Conuma
Release Site(s):	Nitinat River & Lake	Klanawa River	Conuma River	Conuma Conuma Estuary	Tlupana River	Sucwoa River	Canton River	Deserted River
<b>Broodyear:</b>								
1993	28,363,894							
1994	30,831,080							
1995	24,649,925							
1996	31,941,437							
1997	34,830,668							
1998	35,455,056		1,105,067	3,686,051	1,234,402	1,998,626	1,340,117	2,058,209
1999	23,721,507		525,964	1,369,785	1,103,714	1,883,722	1,071,147	1,822,476
2000	5,153,902		543,511	1,296,654	998,400	139,090	1,009,746	269,284
2001	27,093,836	3,162,846	569,118	1,649,290	390,754	200,803	1,070,539	272,395
2002	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Enhanced contributions of chum from major hatchery facilities are based on marking a portion of the fry released with an adipose clip and coded-wire tag (Ad-cwt) or a multiple fin clip (MFC) consisting of a single fin clip such as adipose (Ad) or a double fin clip such as adipose-right ventral (AdRV), and recovery of these marks in the commercial fishery and escapement programs. Marked fry are enumerated individually at marking. Released chum marked with fin clips include the Big Qualicum River (since 1964) and Little Qualicum River (since 1979), the Chilliwack River (since 1980), the Nitinat River (since 1980), Pallant Creek (since 1978), and Conuma River (since 1978). Released chum marked with adipose clips (Ad) and coded-wire-tags (CWT's) include the Puntledge River (since 1980), Chehalis River (since 1983), Inch Creek (since 1978), and Stave River (from 1982 to 1997 when enhancement ceased) with Ad-cwt's. Unmarked fry represented by the mark are enumerated by subtracting egg and fry mortalities from the egg number which is usually calculated using electronic egg counters. Since egg and fry mortality generally is less than 10%, fry enumeration is considered very accurate. Not all release groups are represented by a mark. Contributions for those groups are estimated by associating them with a marked release group with a similar size and release timing.

Table 19 and Table 20 provide a summary of marks applied from 1990 – 2000; note mark information prior to 1990 is not presented in these tables.

Table 19. Chum Salmon Tagged (CWT-Ad) and Released from Canadian Hatchery facilities from 1990 to 2000; marking data prior to 1990 are not presented in this table.

Stock	Brood Year	CWT + Adipose-clip	Adipose - clip	Unclippped	Total Released
Chehalis R	1990	106,647	493	12,714,065	12,821,205
	1991	102,672	7,484	12,320,223	12,430,379
	1992	96,665	4,977	10,275,805	10,377,447
	1993	98,887	3,747	10,568,136	10,670,770
	1994	103,939	4,142	8,804,134	8,912,215
	1995	89,473	5,616	10,894,248	10,989,337
	1996	106,731	391	7,656,991	7,764,113
	1997	102,633	3,038	7,842,567	7,948,238
	1998	102,182	536	3,902,166	4,004,884
Conuma R	1990	55,243	671	0	55,914
Nimpkish R Low	1990	80,146	680	308,238	389,064
	1992	81,991	828	1,085,196	1,168,015
McLaughlin Bay	1990	103,811	1,049	381,669	486,529
	1991	104,881	925	515,842	621,648
	1996	99,763	628	712,971	813,362
	1997	98,974	1,000	908,384	1,008,358
	1998	98,830	1,403	370,024	470,257
Inch Cr	1990	25,400	705	703,660	729,765
	1991	23,496	1,500	828,857	853,853
	1992	49,788	1,672	977,260	1,028,720
	1993	50,157	635	1,098,690	1,149,482
	1994	48,010	1,485	1,037,829	1,087,324
	1995	51,785	848	1,113,189	1,165,822
	1996	48,215	2,538	1,075,929	1,126,682
	1997	49,725	604	971,992	1,022,321
	1998	48,653	1,922	1,070,913	1,121,488
	1999	49,826	98	952,769	1,002,693
	2000	49,759	264	926,658	976,681
	2001	49,931	100	1,124,599	1,174,630
Stave R	1990	128,184	2,096	4,244,662	4,374,942
	1991	125,051	2,683	4,533,557	4,661,291
	1992	68,239	2,996	4,056,861	4,128,096
	1993	99,992	2,019	4,838,239	4,940,250
	1994	95,734	3,797	4,723,244	4,822,775
	1995	97,665	2,320	4,524,242	4,624,227
	1996	95,104	4,646	2,977,339	3,077,089
	1997	49,614	450	2,028,888	2,078,952
Nitinat R	1990	50,285	3,187	3,133,601	3,187,073
	1992	102,813	2,367	6,725,511	6,830,691
Lang Cr	1994	50,501	0	397,805	448,306
	1996	49,348	248	534,871	584,467
	1997	50,876	256	457,900	509,032
Puntledge R	1990	77,004	3,628	5,082,530	5,163,162
	1991	66,339	7,287	3,248,475	3,322,101
	1992	54,106	30,434	4,640,281	4,724,821
	1996	100,939	11,465	3,777,382	3,889,786
	1997	68,848	12,566	4,667,836	4,749,250
Slammon R	1994	50,119	252	489,853	540,224
	1995	99,071	499	535,219	634,789
	1996	49,472	500	552,624	602,596
	1997	47,915	484	444,274	492,673
	1999	100,053	0	505,633	605,686
	2000	99,615	879	500,628	601,122

Table 20. Chum Salmon Finclipped (Ad:Adipose; LV: Left Ventral; RV: Right Ventral; AN: Anal; D: Dorsal) from Canadian Hatchery Facilities from 1990 to 2000

Stock	Brood Year	Clip Type	# Clipped	# Poor Clips	# Unmarked
Big Qualicum R	1990	AdRV	251,875	12,633	45,261,952
	1991	AdRV	253,057	28,332	35,273,168
	1992	AdRV	251,469	16,310	66,570,091
	1993	AdRV	250,370	7,442	63,279,563
	1994	AdRV	251,345	7,556	45,775,992
	1995	AdRV	259,684	5,357	16,862,532
	1996	AdLV	99,979	2,877	1,454,601
	1996	AdRV	216,759	6,250	6,517,105
	1997	AdLV	70,236	1,433	1,223,185
	1997	AdRV	249,992	4,568	29,910,744
	1998	AdRV	254,720	8,562	49,966,270
	1999	AdRV	250,225	5,014	26,422,017
Chilliwack R	1990	RV	149,485	223	2,870,368
	1991	RV	147,461	47	2,846,519
	1992	RV	141,830	17	2,815,923
	1993	RV	147,309	521	2,342,051
	1994	RV	99,513	30	2,966,629
	1995	RV	99,572	22	2,968,212
	1996	RV	98,616	74	2,367,830
Conuma R	1990	AdLV	52,137	312	5,799,086
	1990	AdRV	98,961	4,956	888,825
	1991	RV	99,820	8,620	4,554,059
	1991	AdLV	103,188	5,344	1,445,827
	1992	RV	78,096	3,262	3,874,453
	1992	AdLV	103,073	10,563	1,891,858
	1993	RV	77,960	5,042	2,054,722
	1993	AdLV	100,295	4,638	3,148,504
	1994	AdLV	100,340	2,921	1,983,286
	1995	AdLV	98,782	5,170	1,877,816
	1996	AdLV	93,220	5,281	3,616,157
	1997	AdLV	98,573	3,429	4,964,089
	1998	AdLV	97,907	6,787	4,686,424
	1999	AdLV	99,225	8,549	1,787,975
	2000	AdLV	97,906	4,720	1,655,535
	2001	AdLV	102,059	4,018	2,112,331
Deserted/NWVI	1997	RV	78,085	601	16,003
	1998	RV	74,985	5,359	1,977,865
	1999	RV	75,043	4,560	1,742,873
	2000	RV	76,928	1,174	191,182
Fish+Airport	1998	RV	99,012	1,678	1,507,653
	1999	LV	105,045	1,061	1,367,282
	2000	LV	83,328	17,018	1,634,546
Hirsch Cr	1990	AdRV	99,751	5,318	832,140
	1991	AdLV	99,797	5,610	808,797
	1992	RV	102,853	1,358	787,791
	1993	AdRV	101,735	1,121	1,339,159
	1994	AdRV	101,333	2,270	912,846
	1998	LV	99,441	608	1,314,656
	1999	LV	100,161	742	759,488
Kildala R	2000	LV	101,947	0	748,756
	1995	AdRV	99,727	4,519	635,613
	1996	AdRV	100,297	3,490	591,725
	1997	AdRV	100,876	1,626	650,809



Table 20 con'd

Stock	Brood Year	Clip Type	# Clipped	# Poor Clips	# Unmarked
Kitasoo Cr	1990	LV	166,782	5,158	162,456
	1991	RV	97,099	2,231	242,547
	1992	LV	100,506	878	24,285
	1993	LV	109,524	0	372,986
	1994	LV	79,364	1,620	0
	1994	RV	74,385	1,518	221,664
	1995	LV	76,544	2,501	308,959
	1995	RV	70,261	1,426	31,488
	1996	LV	75,029	0	197,469
	1996	RV	77,597	0	6,791
	1997	RV	86,075	831	4,572
	1997	AdLV	27,345	491	418,588
	1998	LV	108,321	4,783	517,021
	1998	RV	81,579	4,959	27,216
	1999	LV	112,358	2,125	778,632
	1999	RV	81,874	4,589	25,350
Kitimat R	1990	RV	100,058	1,647	3,790,797
	1991	LV	100,105	1,918	4,258,724
	1993	RV	101,478	140	3,669,521
	1994	RV	76,526	582	3,699,425
	1995	RV	75,949	2,006	3,503,411
	1996	RV	58,196	293	2,968,351
	1997	RV	76,964	0	3,749,024
	1998	RV	112,401	639	4,020,702
	1999	RV	100,102	900	3,380,279
	2000	RV	99,732	0	3,587,881
L Qualicum R	1990	AdLV	236,900	13,369	42,433,479
	1991	AdLV	239,525	11,660	31,852,858
	1992	AdLV	247,707	3,367	42,216,634
	1999	AdLV	251,600	4,129	12,510,271
	2001	AdLV	266,330	7,874	21,755,530
Mathers Cr	1990	RV	78,591	1,906	2,014,032
	1991	RV	78,183	1,005	920,812
	1992	RV	65,505	8,096	1,975,302
	1993	RV	75,140	1,533	2,854,966
	1994	RV	53,350	24,820	2,016,372
	1995	RV	73,675	1,543	2,651,003
	1996	RV	76,015	683	2,527,287
Nitinat R	1990	RV	103,582	608	7,486,360
	1990	AdLV	99,945	628	8,890,351
	1990	AdRV	51,590	753	3,197,174
	1991	LV	69,471	107	710,173
	1991	RV	78,265	261	8,877,516
	1991	AdRV	101,372	1,259	9,083,332
	1992	LV	78,396	514	1,429,733
	1992	RV	83,709	101	1,669,100
	1992	AdRV	103,679	462	6,020,621
	1993	LV	78,050	1,657	6,128,243
	1993	RV	82,283	745	5,141,239
	1993	AdRV	102,580	1,188	15,213,898
	1994	LV	79,151	1,731	9,784,240
	1994	RV	79,135	3,949	4,943,642
	1994	AdRV	105,091	2,706	13,471,605
	1995	LV	77,361	616	3,258,407
	1995	RV	77,769	509	3,170,230
	1995	AdRV	99,753	1,519	15,964,115
	1996	LV	77,400	648	10,209,175
	1996	RV	76,406	76	3,720,152
	1996	AdRV	110,656	478	7,793,677
	1997	LV	88,272	964	6,554,665
	1997	RV	82,680	682	6,178,764
	1997	AdRV	84,197	520	13,334,717
	1998	LV	77,356	514	8,305,934
	1998	RV	75,732	106	8,723,288
	1998	AdLV	100,132	534	8,248,614
	1998	AdRV	100,576	627	8,557,977

Table 20 con'd

Stock	Brood Year	Clip Type	# Clipped	# Poor Clips	# Unmarked
<b>Pallant Cr</b>	1990	LV	79,481	1,292	2,934,876
	1990	AdLV	66,008	2,394	2,459,976
	1990	AdRV	64,834	4,212	3,029,629
	1991	LV	78,262	985	2,740,179
	1991	AdLV	71,147	2,854	1,885,343
	1991	AdRV	24,006	1,976	2,724,513
	1992	LV	74,795	1,145	2,264,844
	1992	AdLV	73,245	2,777	1,918,552
	1992	AdRV	75,695	3,221	2,402,039
	1993	LV	73,767	997	2,234,989
	1993	AdLV	72,778	5,243	1,935,413
	1993	AdRV	77,068	5,238	1,963,570
	1994	LV	51,256	11,234	4,004,002
	1994	AdRV	5,801	6,285	3,887,697
	1995	LV	77,917	2,690	9,832,572
	1996	LV	57,512	1,864	9,853,710
	1997	LV	31,803	0	4,659,501
<b>Salloom R</b>	1993	LV	98,648	1,859	1,689,542
	1994	LV	97,125	2,994	1,548,092
	2001	LV	97,015	4,595	1,619,160
<b>Snootli Cr</b>	1990	LV	75,600	379	307,375
	1990	RV	75,311	252	251,297
	1990	AdLV	72,855	2,642	1,127,999
	1991	LV	71,995	3,670	330,160
	1991	RV	71,626	4,168	166,851
	1991	AdLV	69,025	6,412	1,111,351
	1992	LV	74,188	2,015	266,333
	1992	RV	73,569	1,503	161,521
	1992	AdLV	68,471	6,781	1,140,554
	1993	AdLV	96,031	3,948	1,783,736
	1994	AdLV	93,304	6,818	1,575,215
	1995	AdLV	94,857	7,139	1,614,205
	1996	AdLV	66,679	8,241	721,878
	1996	AdRV	72,052	2,229	807,684
	1997	AdLV	70,418	4,647	732,010
	1997	AdRV	67,561	10,648	731,553
	1998	LV	105,182	1,062	1,497,586
	1999	RV	106,211	0	1,565,636
	2000	RV	89,302	12,190	1,458,055
	2001	RV	98,675	5,193	1,655,395
<b>Sucwoa R</b>	1990	LV	76,919	0	2,703,303
	1991	LV	73,163	6,666	2,618,329
	1992	LV	76,448	1,695	1,607,526
	1993	LV	74,869	3,069	1,806,073
	1994	LV	74,880	203	3,039,426
	1995	LV	74,297	0	840,135
	1996	LV	78,930	143	1,332,111
	1997	LV	74,578	211	2,001,294
	1998	LV	78,139	0	1,920,487
	1999	LV	76,297	715	1,806,710
	2000	LV	76,400	0	62,690
	2001	LV	76,516	0	124,287
<b>Thorsen Cr</b>	1995	LV	70,440	5,302	1,589,550
	1996	LV	71,747	3,376	736,323
	1996	RV	73,002	2,258	748,734
	1997	LV	72,691	2,389	749,664
	1997	RV	69,913	4,994	744,332
<b>Tlupana R</b>	1994	RV	72,022	4,079	1,687,290
	1995	RV	72,982	2,079	143,479
	1996	RV	71,924	1,727	1,572,720
	2001	RV	73,928	2,784	314,042

### United States

A summer chum salmon supplementation program was begun in 1992 at the Quilcene National Fish Hatchery to address severe declines in the numbers of summer chum returning to the Quilcene River and Hood Canal. The first brood (1992) was coded wire tagged to evaluate returns and to confirm where summer chum might be intercepted in marine fisheries. Concerns over the physical impacts of tagging small fish, and limited sampling for tags in chum fisheries, led to the discontinuation of the CWT effort. In more recent years an adipose-only clip has been applied to aid in identifying hatchery fish for terminal fisheries management and project evaluation purposes. Table 21 provides a summary of marks applied at this program.

Table 21. Summer Chum Salmon Marking and Release from Quilcene National fish Hatchery

<b>Brood Year</b>	<b>CWT+adclip</b>	<b>Adipose-clip</b>	<b>Unclipped</b>	<b>Total release</b>
1992	53,067	7,422	155,953	216,441
1993	0	0	24,784	24,784
1994	0	0	343,550	343,550
1995	0	0	441,167	441,167
1996	0	0	612,598	612,598
1997	0	313,212	27,532	340,744
1998	0	333,409	10,121	343,530
1999	0	168,572	13,139	181,711
2000	0	393,055	21,298	414,353
2001	0	344,675	7,034	351,709

A number of other hatchery supplementation and reintroduction programs for summer chum in the Hood Canal and Strait of Juan de Fuca regions have utilized otolith marks to aid in assessing the success of the programs and to determine the proportion of hatchery and natural origin fish on the spawning grounds. Table 22 provides a summary of otolith marks applied to summer chum.

Table 22. Numbers of summer chum salmon released with otolith marks, by brood year and location.

Brood Year	Sequim	Discovery	Chimacum	Big Beef	Hamma Hamma	Lilliwaup	Union
1992	-	19,200	-	-	-	-	-
1993	-	44,000	-	-	-	-	-
1994	-	2,000	-	-	-	-	-
1995	-	38,808	-	-	-	-	-
1996	-	62,000	-	-	-	-	-
1997	-	71,821	-	-	12,000	14,200	-
1998	-	67,832	-	214,936	2,800	17,200	-
1999	3,880	34,680	39,170	39,800	51,600	17,400	-
2000	25,900	90,435	73,300	80,550	55,400	14,800	75,876
2001	54,515	163,850	18,100	80,925	49,500	38,000	

## 6.4 DNA

### Canada

To order to assess the proportion of Cowichan and Goldstream chum in the 1999 Area 19 ESSR fishery, DNA samples were collected during this fishery. Fishery amples were taken from several sites in Area 19 to assess any stock mixing differences. The baseline consist of two stocks Goldstream and Cowichan rivers and was obtained 1997 and 1998. To ensure that the baseline data are current, DNA samples were re-taken from Goldstream and Cowichan rivers.

### United States

DNA samples have also been collected from a number of U.S. fisheries and stocks as part of an assessment program for Threatened Hood Canal and Strait of Juan de Fuca summer chum. Table 23 provides a summary of the samples collected. Most of these samples have yet to be analysed.

Table 23. Genetic, otolith, and scale collections made from summer chum salmon in the eastern Strait of Juan de Fuca and Hood Canal, in number of samples taken.				
	Allozyme	DNA	Otoliths	Scales
1999	93	115	221	577
2000	201	506	399	1,158
2001	239	669	978	2,127
2002	0	388	1,546	2,416

## 7. REFERENCES

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## ATTACHMENT 1:

### CHAPTER 6 OF ANNEX IV OF THE PACIFIC SALMON TREATY

#### Chapter 6

#### Southern British Columbia and Washington State Chum Salmon

The provisions of this Chapter shall apply for the period 1999 through 2008.

1. The Parties shall maintain a joint Chum Technical Committee ("the Committee") reporting, unless otherwise agreed, to the Southern Panel and the Commission. The Committee will undertake to, *inter alia*,:

- (a) identify and review the status of stocks of primary concern;
  - (b) present the most current information on harvest rates and patterns on these stocks, and develop a joint database for assessments;
  - (c) collate available information on the productivity of chum stocks to identify escapements which produce maximum sustainable harvests and allowable harvest rates;
  - (d) present historical catch data, associated fishing regimes, and information on stock composition in fisheries harvesting those stocks;
  - (e) devise analytical methods for the development of alternative regulatory and production strategies;
  - (f) identify information and research needs, to include future monitoring programs for stock assessment; and
  - (g) for each season, make stock and fishery assessments and evaluate the effectiveness of management.
2. In the years 1999 through 2008, Canada will manage its Johnstone Strait, Strait of Georgia, and Fraser River chum fisheries to provide continued rebuilding of depressed naturally spawning chum stocks, and, to the extent practicable, minimize increased interceptions of United States origin chum. Terminal fisheries conducted on specific stocks with identified surpluses will be managed to minimize interception of non-targeted stocks.
3. In the years 1999 through 2008,
- a) for Johnstone Strait run sizes less than 3.0 million

- (i) Canada, taking into account the catch of Canadian chum in United States Areas 7 and 7A, will limit its harvest rate in Johnstone Strait to less than 10 percent, resulting in a Johnstone Strait catch level of up to 280,000 chum; and
- (ii) when the catch in Johnstone Strait is 280,000 chum or less, the United States catch of chum in Areas 7 and 7A

shall be limited to chum taken incidentally to other species and in other minor fisheries, but shall not exceed 20,000, provided, however, that catches for the purposes of electrophoretic sampling shall not be included in the aforementioned limit;

(b) for Johnstone Strait run sizes from 3.0 million to 3.9 million

(i) Canada, taking into account the catch of Canadian chum in United States Areas 7 and 7A, will limit its harvest rate in Johnstone Strait to 20 percent, resulting in a Johnstone Strait catch level of 280,000 to 745,000 chum; and

(ii) when the catch in Johnstone Strait is from 280,000 to 745,000 chum, the United States catch of chum in Areas 7 and 7A shall not exceed 120,000;

(c) for Johnstone Strait run sizes of 3.9 million and greater

(i) Canada, taking into account the catch of Canadian chum in United States Areas 7 and 7A, will harvest at a rate in Johnstone Strait of 30 percent or greater, resulting in a Johnstone Strait catch level of 745,000 chum or greater; and

(ii) when the catch in Johnstone Strait is 745,000 chum or greater, the United States catch of chum in Areas 7 and 7A shall not exceed 140,000;

(d) it is understood that the Johnstone Strait run sizes, harvest rates, and catch levels referred to in 3(a), 3(b), and 3(c) are those determined in season, in Johnstone Strait, by Canada; and

(e) the United States shall manage in a manner that, as far as practicable, maintains a traditional proportion of effort and catch between United States Areas 7 and 7A, and avoids concentrations of effort along the boundary in Area 7A.

4. In the years 1999 through 2008, the United States shall conduct its chum fishery in the Strait of Juan de Fuca (United States Areas 4B, 5 and 6C) so as to maintain the limited effort nature of this fishery, and, to the extent practicable, minimize increased interceptions of Canadian origin chum. The United States shall continue to monitor this fishery to determine if recent catch levels indicate an increasing level of interception.

5. If, in any year, the United States chum fishery in Areas 7 and 7A fails to achieve the catch levels specified in paragraphs 3(a)(ii), 3(b)(ii) and 3(c)(ii), any differences shall be compensated by adjustments to the Areas 7 and 7A fishery in subsequent years, except that chum catches below the level specified in paragraph 3(a)(ii) shall not be compensated.

6. Catch compositions in fisheries covered by this Chapter will be estimated by post-season analysis using methods agreed upon by the Committee.

7. Canada will manage the Nitinat net chum fishery to minimize the harvest of non-targeted stocks.
8. In the years 1999 through 2008, Canada shall conduct electrophoretic sampling of chum taken in the West Coast Vancouver Island troll fishery if early-season catch information indicates that catch totals for the season may reach levels similar to 1985 and 1986. Sampling, should it occur, will include catches taken from the southern areas (Canadian Areas 121-124).
9. During the period of August 1 through September 15 of each year, Canada will require the live release of chum salmon from all purse seine gear fishing in the Strait of Juan de Fuca (Canadian Area 20) and the United States will require the same for non-Indian seine fisheries in Areas 7 and 7A. Note: purse seine fisheries are not permitted in U.S. Areas 4B, 5 and 6C.
10. Canada and the United States shall assess catch levels and make attempts to collect additional genetic samples from any chum salmon caught during the August 1 through September 15 time period in the boundary area fisheries (U.S. Areas 4B, 5, 6C, 7 and 7A; Canadian Areas 18, 19, 20, 21 and 29).



## ATTACHMENT 2:

### U.S. AND CANADIAN STATISTICAL AREA MAPS





