



Environment Canada

Environnement Canada

Pêcheries
Service

Service des pêches
et des sciences de la mer

THE 1974 RETURN OF CHUM SALMON STOCKS TO THE JOHNSTONE STRAIT- FRASER RIVER STUDY AREA, AND PROSPECTS FOR 1975

A. D. ANDERSON

TECHNICAL REPORT SERIES PAC/T-75-14

SOUTHERN OPERATIONS BRANCH
PACIFIC REGION

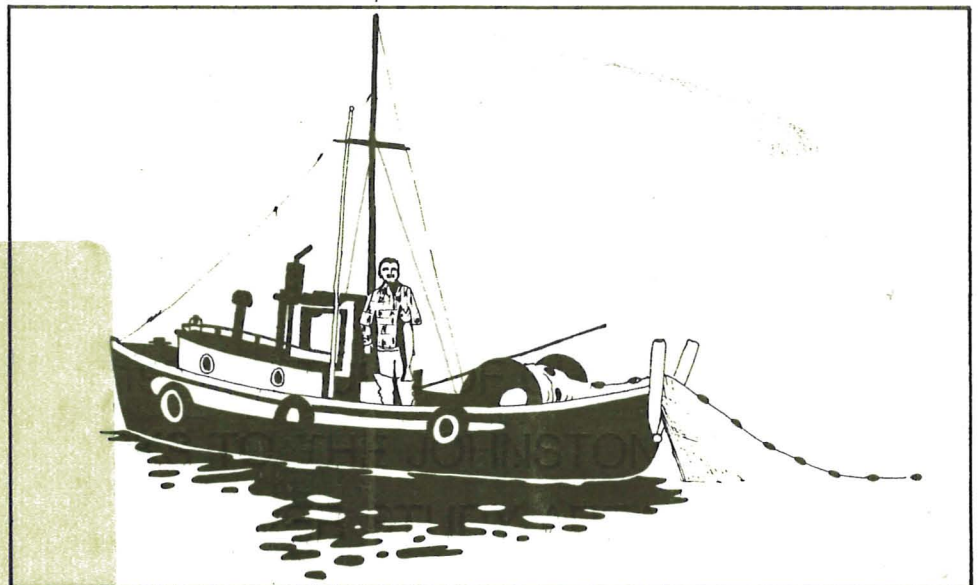


TABLE OF CONTENTS

	<i>Page</i>
LIST OF TABLES	ii
LIST OF FIGURES	ii
INTRODUCTION	1
THE 1974 SEASON REVIEW	1
The Fishery	
The Escapement	
The Stock Size	
SALMON DEVELOPMENT PROJECTS	6
Big Qualicum River	
Inches and Blaney Creeks	
THE 1975 SEASON	9
Prospects for the 1975 Level of Abundance	
(a) Magnitude of the Age Five Return	
(b) Magnitude of the Age Four Return	
(c) Magnitude of the Age Three Return	
(d) Magnitude of the Fraser River Stock	
(e) Magnitude of the Big Qualicum River Stock	
(f) Forecast for the 1975 Return	
MANAGEMENT PROPOSALS FOR 1975	10
Proposed Fishing Pattern	
(a) Areas 12 and 13	
(b) Area 14	
(c) Areas 15, 16, 17 and 18	
(d) Area 29	
APPENDICES	11
A. Major regulations and fishing effort by statistical area and week during the 1974 chum season	
B. Early-season chum catches in Johnstone Strait and Study Area total return	
C. Johnstone Strait chum salmon test-fishing	
D. Chum salmon escapements in thousands of fish, recorded by stream and totalled by sub-area (1964-1974)	
E. Pink and chum salmon production in the Johnstone Strait-Fraser River area (1956-72)	

LIST OF TABLES

<i>Table</i>		<i>Page</i>
1	Catch, escapement, and percent exploitation of Study Area chum salmon (1960-1974)	2
2	Catch of Study Area chum salmon by statistical area and week during 1974	2
3	Days fishing and percent exploitation of Study Area chum salmon in Johnstone Strait (1967-1974)	2
4	Chum salmon catches in the Fraser River and Point Roberts fisheries (1951-1974)	3
5	Escapements of Study Area chum salmon by sub-area (1960-1974)	4
6	Age composition of the 1974 Study Area chum salmon return	5
7	Total production of Study Area chum salmon (1960-1971)	6
8	Big Qualicum chum fry production, adult returns, and commercial catch (1959-1974)	6
9	Survival of Big Qualicum chum fry, adults and ratio of return-to-escapement (1959-1974)	7
10	Big Qualicum spawning channel chum fry production (1967-1974)	7
11	Survival of Big Qualicum spawning channel adults and ratio of return-to-escapement (1967-1970)	8
12	Inches and Blaney Creeks chum fry production (1970-1974)	8

LIST OF FIGURES

<i>Figure</i>		<i>Page</i>
1	The Johnstone Strait-Fraser River chum salmon study area	1
2	Timing of chum salmon entering upper Johnstone Strait (* indicates week of peak entrance)	4
3	Total stock and escapement of Study Area chum salmon for 1949-1974 and forecast for 1975	5
4	Schematic diagram of the Inches and Blaney Creeks gravel upwelling incubation units	9

INTRODUCTION

The status of the Johnstone Strait-Fraser River Study Area chum salmon stocks has been analyzed and reported annually since 1961. This fifteenth report, a continuation of that study, includes a summary of the 1974 return, a forecast of the 1975 level of abundance, and recommendations for the 1975 commercial chum salmon fishery. Also included are brief status reports on chum salmon production from the Big Qualicum River, Blaney and Inches Creeks Salmon De-

velopment Projects.

The Study Area, consisting of the Johnstone Strait and Strait of Georgia regions and all tributary streams, is for the purpose of management and analysis, divided into thirteen sub-areas (Fig. 1). In total, there are approximately 120 streams contributing to the chum salmon harvest. Most of the chum salmon stocks migrate to these streams from the north via Johnstone Strait.

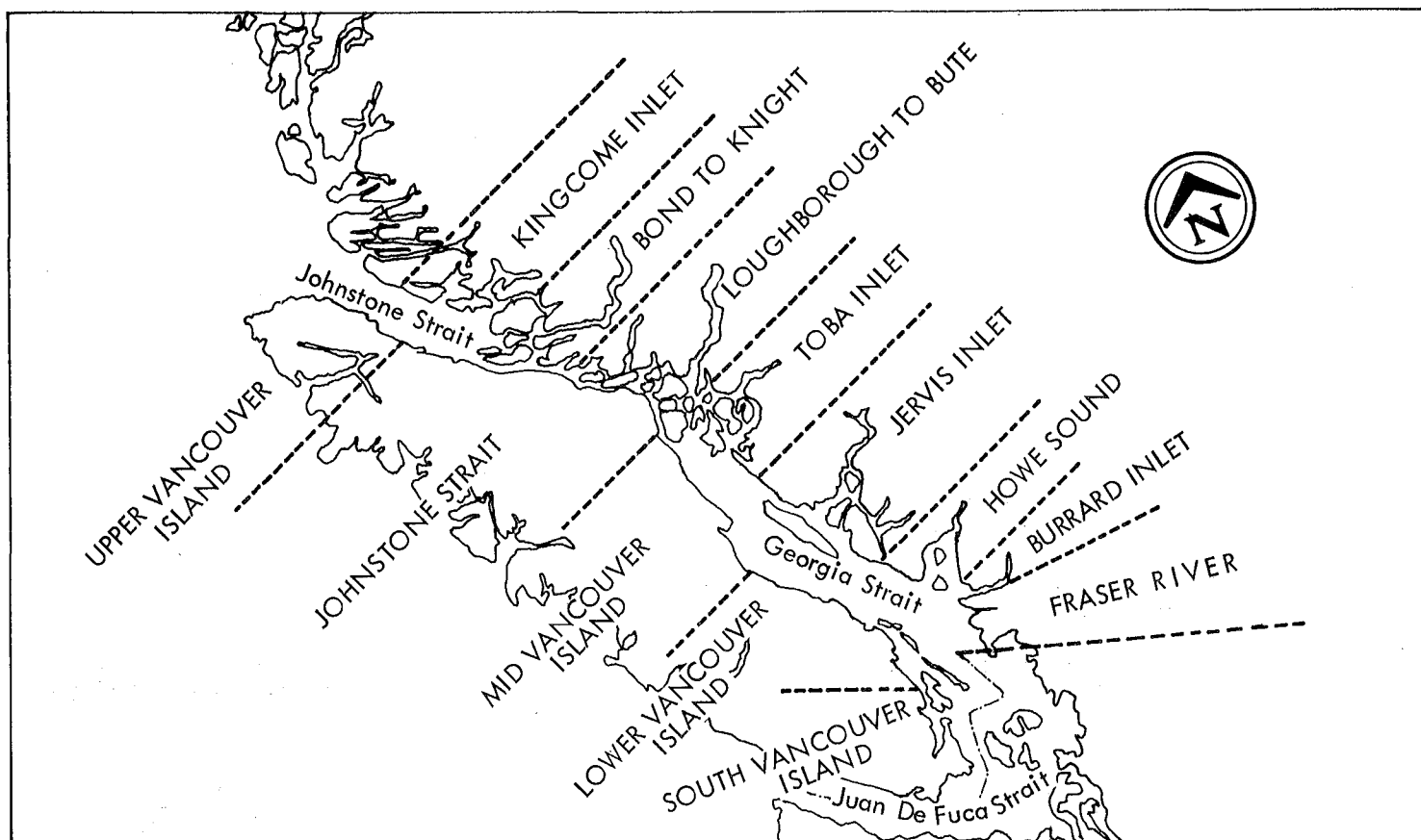


Figure 1. The Johnstone Strait-Fraser River chum salmon study area.

THE 1974 SEASON REVIEW

The escapement required to produce maximum catches in the Study Area is 2.0 million. The 1974 return of chum salmon was projected at 1,554,000 fish. It was, therefore, obvious that the entire production expected in 1974 would be less than the desired escapement. However, in order to harvest those individual stocks expected to return at a fishable abundance, and on the other hand obtain a minimum acceptable escapement of those stocks expected to return at lower levels of abundance, a limited exploitation consisting of two two-day fisheries in Johnstone Strait was proposed. It was intended that exploitation of the stronger stocks be accomplished by local fisheries in Areas 14 and 29 to supplement exploitation in Johnstone Strait. The proposed regulations, for the projected stock size, were developed to provide a catch of about 390,000 chum salmon from the stronger stocks and provide a minimum acceptable escapement of 1,164,000. This escapement would have provided no rehabilitation over the major 1970 brood year escapement of 1,157,000.

The Fishery

The catch of chum salmon within the Study Area was approximately 367,700 fish (Table 1). This catch, just six percent less than that projected, represents a twenty percent exploitation rate. Catch records detailed by week and statistical area are summarized in Table 2. As well, details of the weekly fishing, including days, fleet size and major regulations are summarized in Appendix A.

Early season commercial net catches in Johnstone Strait during the September 8-10 fishery indicated that chum salmon were returning at a level of abundance comparable to that projected (Append. B). As a result of these early indications, Johnstone Strait remained closed to commercial fishing until September 29 as proposed.

The following two-day fishery of September 29-October 1 was mainly to harvest the Loughborough to Bute Inlet stocks. This catch confirmed that study area chums were returning at the projected level of abundance. During the following two

TABLE 1. Catch, escapement, and percent exploitation of Study Area chum salmon (1960-1974).

Year	Catch	Escapement	Total Return	Percent Exploitation
1960	680,000	720,400	1,400,400	49
1961	360,800	647,400	1,008,200	36
1962	261,200	715,000	976,200	27
1963	359,400	698,100	1,057,500	34
1964	122,500	884,800	1,007,300	12
1965	35,800	401,500	437,300	8
1966	60,900	983,400	1,044,300	6
1967	195,000	709,000	904,000	22
1968	863,200	1,877,300	2,740,500	31
1969	608,400	1,070,300	1,678,700	36
1970	1,025,200	1,157,000	2,182,200	47
1971	116,200	721,200	837,400	14
1972	1,936,200	1,971,700	3,907,900	50
1973	2,896,700	1,820,500	4,717,200	61
1974	367,700	1,429,100	1,796,800	20
Current Four Year Average	1,329,200	1,485,625	2,814,825	47

weeks, test-fishing did not indicate a sufficient level of abundance which would warrant harvesting (Append. C). As a result, Johnstone Strait remained closed for a second two-week period until October 20.

The final two-day fishery in Johnstone Strait was permitted during October 20-22 to harvest the anticipated stronger stocks destined to Mid-Vancouver Island. However, catches from this fishery were less than anticipated, indicating that

these chums, mainly Big Qualicum River, were returning at less than the projected level. As a result, the Johnstone Strait fishery remained closed for the balance of the season.

The Johnstone Strait catch which occurred during the main two fisheries totalled about 215,000 chums, which represents a twelve percent exploitation rate. Since 1967, exploitation of Study Area stocks has averaged 2.9 percent for each day of fishing in Johnstone Strait. The 1974 rate of 3.0 percent is comparable (Table 3).

TABLE 3. Days fishing and percent exploitation of Study Area chum salmon in Johnstone Strait (1967-1974).

Year	Days ¹ Fishing	Exploitation ¹	
		%	%/Day
1967	6	16.3	2.7
1968	6	23.6	3.9
1969	10	28.8	2.9
1970	11	34.4	3.1
1971	4	11.1	2.9
1972	16	34.9	2.2
1973	20	48.7	2.4
1974	4	12.0	3.0
Average			2.9

¹ From the third week of September.

TABLE 2. Catch of Study Area chum salmon by statistical area and week during 1974.

Week Ending	Statistical Area					Total
	12	13	14	17	29	
To Aug. 31	15,855	928	-	-	560	
Sept. 7	-	-	-	-	409	
Sept. 14	10,157	1,279	-	-	490	
Sept. 21	-	-	-	-	-	
Sept. 28	-	-	-	-	-	
Oct. 5	61,418	40,151	-	-	16,634	
Oct. 12	-	-	-	-	-	
Oct. 19	-	-	-	-	-	
Oct. 26	42,630	71,266	-	-	23,352	
Nov. 2	-	-	10,310	15,812	-	
Nov. 9	-	-	-	-	47,114	
Totals ¹	133,593	114,107	10,719	16,194	93,129	367,742

¹ Includes test-fishing catches.

In Area 29, catches during the fishery of September 30-October 1 indicated that early Fraser River chums, although this early segment had been protected in Johnstone Strait, were returning at a low level of abundance. As a result, the Fraser River remained closed for a two week period until October 24. During this week, test-fishing indicated a level of abundance which would permit a one-day fishery. However, because of critically low water levels, Area 29D remained closed for the protection of milling late coho and early chum salmon. The catch from this fishery was less than anticipated. Heavy fog conditions possibly reduced the effectiveness of the fishing fleet. The last fishery in Area 29 occurred during November 4-5.

In addition to catches taken within the Study Area, Fraser River chums may be exploited elsewhere. In the waters adjacent to Point Roberts, for example, a small fleet of American gillnets and seines operates during the chum

TABLE 4. Chum salmon catches in the Fraser River and Point Roberts fisheries (1951-1974).

Year	Fraser River		Point Roberts	
	Stock ¹	Catch	Catch	Percent of Stock
1951	645,760	485,990	72,250	11.2
1952	710,010	553,610	78,760	11.1
1953	453,830	326,560	19,130	4.2
1954	534,790	451,520	37,070	6.9
1955	204,930	99,780	30,630	14.9
1956	101,930	70,690	11,040	10.8
1957	199,760	119,560	5,680	2.8
1958	287,570	195,330	22,850	7.9
1959	370,960	221,190	26,460	7.1
1960	321,280	67,290	19,680	6.1
1961	211,880	47,880	11,200	5.3
1962	227,570	47,570	5,530	2.4
1963	267,790	53,790	7,270	2.7
1964	385,820	60,820	8,670	2.2
1965	196,940	11,940	3,160	1.6
1966	443,870	13,870	9,010	2.0
1967	258,540	46,540	8,420	3.3
1968	1,024,410	202,370	72,200	7.0
1969	479,030	88,930	31,080	6.5
1970	480,000	178,920	55,120	11.4
1971	378,410	21,690	13,900	3.7
1972	836,070	256,370	177,770	21.2
1973 ²	643,520	190,520	137,270	21.3
1974	658,430	93,130	94,630	14.1

¹ Fraser River escapement plus Area 29 catch. Years 1951 to 1959 do not include mainstem escapement.

² Iverson Dock Line of Point Roberts fishing area in effect June 16, 1973.

salmon season. As this area lies only a few miles south of the Fraser River, chum salmon taken in this fishery are most probably of Fraser River origin. Annual catch statistics during 1951-1974, as reported by the Washington Department of Fisheries, show the catches in this fishery have ranged from 3,160 in 1965 to 177,770 in 1972 (Table 4). These catches, fluctuating in relationship to the abundance of Fraser River chum, declined from an average of 47,570 during 1951-1955, to 11,580 during 1956-1967, and then increased considerably to 83,140 in 1968-1974. During these periods, the average catches represented, respectively, 9.7, 4.5, and 12.2 percent of the Fraser River stock.

The Escapement

The escapements recorded in 1974 are listed in Appendix D by major streams and summarized by sub-areas in Table 5. The estimates of escapement during 1960-1969 to the Fraser River are based on tag and recapture information. Since 1970, the estimates are based on the relationship of past tagging estimates to those obtained by visual observations. The 1974 estimates of escapement to the Fraser River are based on this relationship and include a calculated escapement to the mainstream river.

The 1974 escapement, totalling approximately 1,429,100 chum salmon, continues the gradual trend of increased escapements and represents a 23 percent increase over the major brood year of 1970. The escapements to seven of the thirteen sub-areas represented reductions from those recorded in the major brood of 1970, whereas the remaining six represented increases (Table 5).

In 1974, chum salmon returning to the Upper Vancouver Island sub-area were given substantial protection by the Goletas Channel closure. However, the 1974 escapement of just 1,700 chums was down from the 4,200 chums in the major brood of 1970, and was down from the ten year average of 6,000 chums.

In the Kingcome Inlet sub-area, the escapement of 63,000 chums was a significant increase over that of 24,300 chums in 1970, and the ten year average of 26,400 chums. The escapement of 45,000 chums to the Kingcome River was a substantial improvement over the 15,000 in 1970. In general, significant increased escapements have occurred in all major chum streams in this sub-area since 1964.

In the Bond to Knight Inlet sub-area, the escapement of 62,300 chums was down from the 92,900 in 1970, and down from the ten year average of 82,200. In the Glendale River, for a notable example, an escapement of just 2,000 chums occurred as compared to 35,000 in 1970. However, escapements to the Klini-Klini, Viner and Waterfall Rivers, although inadequate, were comparable to those in 1970.

Escapements to the Johnstone Strait sub-area totalled 8,600 chum. This was down from 22,600 in 1970, and down from the ten year average of 27,000. The major reduction in escapement occurred in the Nimpkish River. In 1974, chums returning to the Nimpkish were protected by the extended Nimpkish River boundary. However, an escapement of just 5,000 chums was recorded. This escapement was down from the 18,000 in 1970, and down from the ten year average of 21,000.

In the Loughborough to Bute Inlet sub-area, although the escapement of 81,300 chums was down from 117,500 in 1970, it was similar to the ten year average of 83,600. In the Southgate River, an escapement of 35,000 was recorded, up from the 7,500 in 1970.

In the Mid-Vancouver Island sub-area, the escapement of 233,100 chums, although down from 298,700 in 1970, was

TABLE 5. Escapements of Study Area chum salmon by sub-area (1960-1974).

Sub-Area	Average 1960-63	Average 1964-67	1968	1969	1970	1971	1972	1973	1974
Upper Vanc. Is.	10,020	7,070	16,000	4,850	4,150	530	4,650	2,160	1,700
Kingcome Inlet	21,820	15,880	21,700	8,700	24,300	6,350	51,900	87,000	63,000
Bond to Knight	92,730	68,830	73,750	74,060	92,930	11,700	115,650	178,250	62,250
Johnstone St.	30,590	25,550	59,360	10,930	22,580	10,150	32,480	32,050	8,550
Lough. to Bute	25,150	32,090	90,250	28,150	117,530	21,100	235,650	215,250	81,250
Mid-Vanc. Is.	128,780	106,970	336,300	232,400	298,680	165,360	246,650	321,370	233,120
Toba Inlet	13,460	18,160	77,500	18,900	9,650	23,050	50,300	11,150	27,210
Jervis Inlet	63,040	26,700	93,750	96,650	64,920	40,690	88,410	92,450	90,560
Lower Vanc. Is.	14,090	43,540	46,180	48,040	56,440	32,500	104,350	66,360	50,620
South. Vanc. Is.	54,880	83,080	123,000	94,500	47,750	23,000	122,000	111,500	108,000
Howe Sound	34,430	24,980	102,500	48,000	100,000	22,500	305,000	215,000	130,000
Burrard Inlet	3,250	3,880	15,000	15,000	15,000	7,500	35,000	35,000	7,500
Fraser River	203,000	288,000	822,000	390,100	303,080	356,720	579,700	453,000	565,300
Totals	695,240	744,730	1,877,330	1,070,280	1,157,010	721,150	1,971,740	1,820,540	1,429,060

greater than the ten year average of 202,900. In the Little Qualicum River, a reduced escapement of 65,000 chums occurred as compared to 104,800 in 1970. An increased escapement of 45,000 occurred in the Puntledge River as compared to 34,000 in 1970.

Chum salmon returning to the Toba Inlet sub-area were protected in Johnstone Strait by the closures during the weeks ending October 12 and 19 (Fig. 2). The escapement of 27,200 chums, although inadequate, was greater than the 1970 escapement of 9,700 and was similar to the ten year average of 26,300. In the Toba River, an increased escapement of 12,000 chums occurred as compared with 2,000 in 1970.

In the Jervis Inlet sub-area, the escapement of 90,600 chums was up from 64,900 in 1970, and up from the ten year average of 58,400. Increased escapements of 15,000 and 25,000 chums occurred in the Pender Harbour Creeks and the Tzoonie River.

In the Lower Vancouver Island sub-area, the escapement of 50,600 chums was comparable to that in 1970 and to the ten year average.

In the Southern Vancouver Island sub-area, the escapement of 108,000 chums was up from both the 47,800 in 1970 and the ten year average of 85,400. Chum salmon returning to the Cowichan River totalled 75,000 as compared to 35,000 in 1970. In 1974, Cowichan River chums were protected in Johnstone Strait by the early season closure.

In the Howe Sound sub-area, the escapement of 130,000 chums was up from both 100,000 in 1970 and the ten year average of 89,300. Escapements greater than those of 1970 occurred in the Cheakamus and Squamish Rivers.

In the Fraser River sub-area, the escapement of 565,300 chums was up from both the 1970 escapement of 303,000 and the ten year average of 405,700. Near optimum escapements of 52,200, 63,700 and 63,700 occurred in the Chehalis, Harrison and Stave Rivers respectively.

The Weaver Creek escapement of 35,000 chums was up considerably from that of 1,500 in the 1970 brood. This increased escapement, as well as those of 1972 and 1973, are undoubtedly the result of the increased fry production

from the spawning channel at Weaver Creek. The Vedder-Chilliwack-Switzer system of 57,300 chums, although inadequate, was comparable, though slightly less than in 1970.

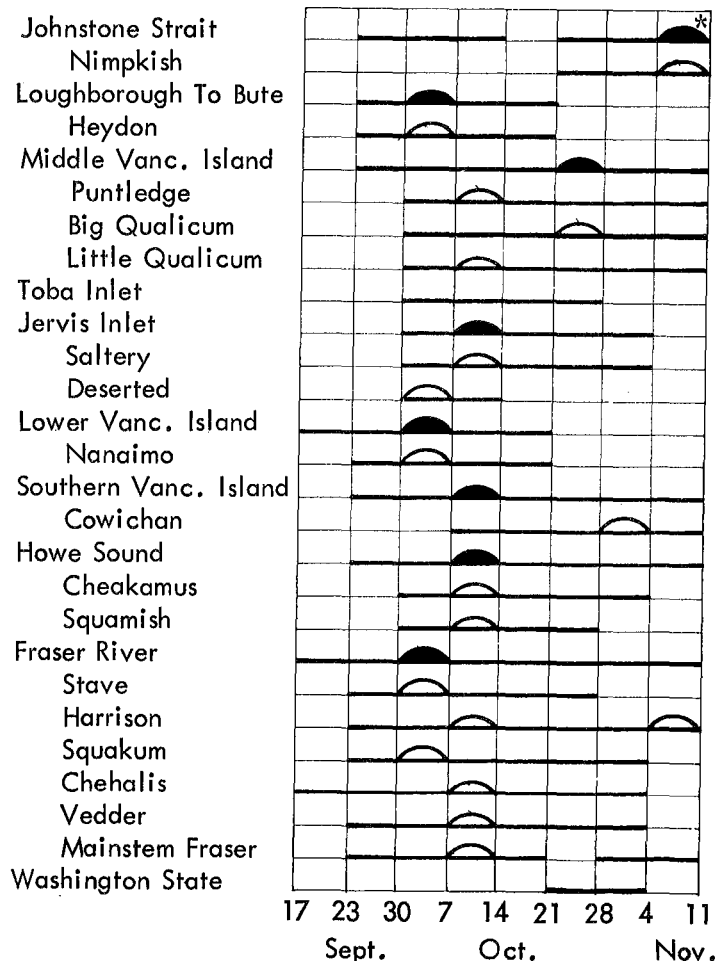


Figure 2. Timing of chum salmon entering upper Johnstone Strait (*indicates week of peak entrance).

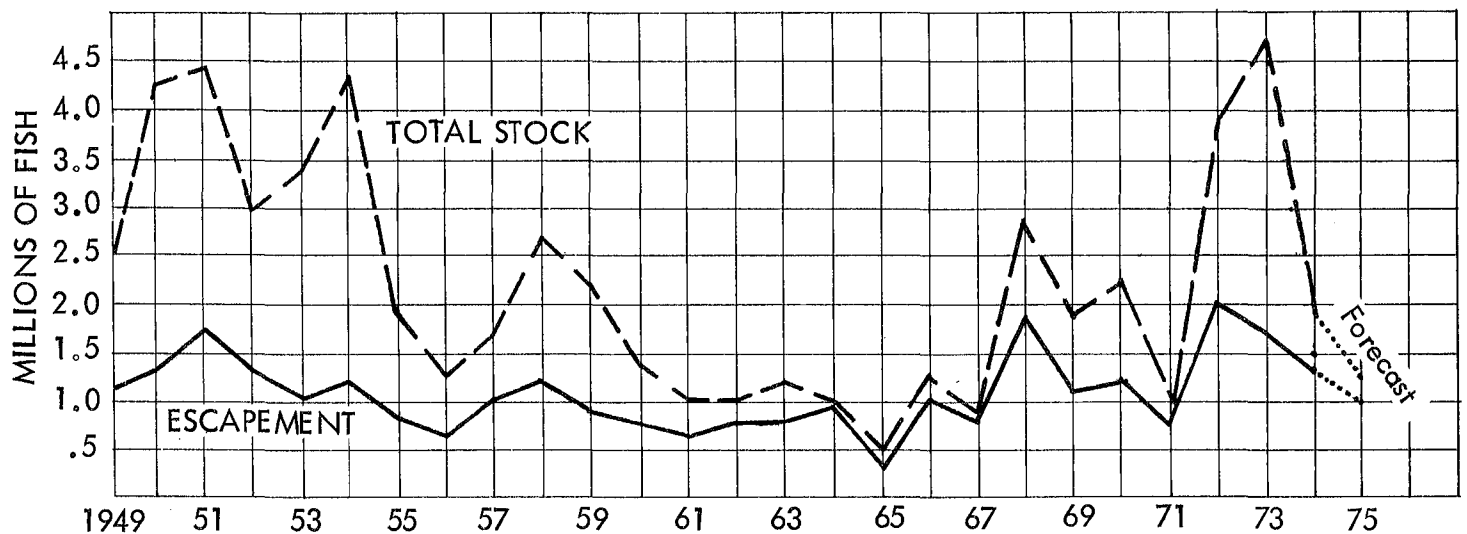


Figure 3. Total stock and escapement of Study Area chum salmon for 1949-1974 and forecast for 1975.

The Stock Size

The total 1974 chum salmon return to the Study Area was 1,796,800 and represents a less than average return. However, the escapement does maintain the gradual trend of increased escapements recorded since the total chum fishing closures in 1965 and 1966. This trend of stock rehabilitation, through increased escapements by regulation, is evident in Figure 3. Escapements during 1960-1966 averaged 0.72 million and never exceeded 1.0 million. Since 1966, escapements have averaged 1.34 million, and in three of these years, exceeded 1.8 million. If the current trend continues, rehabilitation would be achieved in the early 1980's.

TABLE 6. Age composition of the 1974 Study Area chum salmon return.

Week Ending	Sample Size	Percent at Age			
		<u>3</u>	<u>4</u>	<u>5</u>	<u>6</u>
<u>To</u>					
Sept. 14	335	10.7	45.7	43.3	0.3
Sept. 21	273	12.8	51.6	35.6	0.0
Sept. 28	362	14.6	49.8	34.8	0.8
<u>From</u>					
Oct. 5	421	19.7	54.2	25.6	0.5
Oct. 12	265	23.1	52.1	24.5	0.0
Oct. 19	348	22.1	52.6	24.7	0.6
Oct. 26	316	25.6	56.3	18.1	0.0
Nov. 2	262	20.6	58.0	21.4	0.0
Season	2,582	20.9	53.2	25.7	0.2

The 1974 return consisted of age three chums returning from the 1971 escapement, age four from the 1970 escapement, age five from the 1969 escapement, and age six from the 1968 escapement. Age analysis of the weekly scale samples, taken from the Johnstone Strait commercial and test-fishing catches (Table 6) and weighted to the relative weekly test-fishing abundance, indicated the age composition of the 1974 return was 20.9 percent or 375,000 age three chums, 53.2 percent or 955,900 age four chums, 25.7 percent or 461,800 age five chums, and 0.2 percent of 3,600 age six chums. The occurrence of age six chums, more common to north coast areas than south coast, is unusual.

The return for each of the three major age classes has been calculated for the brood year 1960 to 1970 (Table 7). For brood years 1960 to 1966, the return of age three chums averaged 24.2 percent and ranged from 38.8 percent in 1961 to 13.3 percent in 1962. During this period, the age fives averaged 2.5 percent and ranged from 5.2 percent in 1961 to 1.3 percent in 1965. The age four proportion, remaining relatively constant, averaged 68.5 percent and ranged from 56.0 percent in 1961 to 85.0 percent in 1962. Beginning with the 1967 brood, however, the proportion of age threes has decreased while the age fives have increased. This trend of older age class production was marked by the high proportion of age fives and the significant number of age six chums from the 1968 brood. The age five component of 461,800 chum salmon in the 1974 return represented 10.1 percent of the 1969 brood production. This is down from the high of 16.7 percent from the 1968 brood. Returns to date from the 1970 and 1971 broods, as well as the forecast of production from the 1971 brood (Append. E), indicate this recent trend may be completed and suggest that the proportions of age three and age five chums may revert to their former levels prior to 1967. The direction that this trend takes for the 1972 brood will have a marked effect on the age three component of the 1975 return.

TABLE 7. Total production of Study Area chum salmon (1960-1971).

Brood Year	Spawning Escapement	3 Years	4 Years	5 Years	Total Return From Brood	Percent Return Age 3	Return-to-Escapement
1960	720,400	386,000	794,800	17,100	1,197,900	32.2	1.66:1
1961	647,400	202,500	292,100	27,200	521,800	38.8	0.81:1
1962	715,000	128,100	815,600	16,300	960,000	13.3	1.34:1
1963	698,100	201,600	321,800	8,200	531,600	37.9	0.76:1
1964	884,800	566,000	2,173,200	73,900	2,813,100	20.1	3.18:1
1965	401,500	559,100	940,100	19,600	1,518,800	36.8	3.78:1
1966	983,400	664,800	1,992,300	105,500	2,762,600	24.1	2.81:1
1967	709,000	170,200	414,500	74,300	659,000	25.8	0.93:1
1968	1,877,300	317,400	3,548,300	773,600	4,639,300	6.8	2.47:1
1969	1,070,300	285,300	3,816,200	461,800	4,563,300	6.3	4.26:1
1970 ¹	1,157,000	127,400	955,900		1,083,300	11.8	0.94:1
1971	721,100	375,500					
1972	1,971,700						
1973	1,820,500						
1974	1,433,300						
Current Four Year Average						12.7	2.15:1

¹ Incomplete, five year old contingent returns in 1975.

SALMON DEVELOPMENT PROJECTS

Big Qualicum River

Big Qualicum River chum fry production from the 1974 brood totalled 45.9 million (Table 8). This fry production, greater than the 36.9 million average recorded for twelve years of flow control, compares favourably with the current four year average of 44.6 million.

The total 1974 return of Big Qualicum chums was projected at 303,000. It was anticipated that 28,000 adults would be harvested in Johnstone Strait, and to achieve an escapement of 125,000, an additional 150,000 would be harvested in local fisheries of Area 14. Analysis of the catch and mark information from the Johnstone Strait fishery of October

TABLE 8. Big Qualicum chum fry production, adult returns, and commercial catch (1959-1974).

Brood Year	Escape-ment	Fry Production (Millions)	Returns			
			Year of Return	Total Return	Commercial Catch	Escapement
1959	98,500	21.1				
1960	60,000	4.5	1963	-	No Estimate	37,900
1961	13,800	4.5	1964	-	No Estimate	36,400
1962	46,700	6.9	1965	18,900	No Fishery	18,900
<u>Controlled Flow</u>						
1963	37,900	20.9	1966	53,800	No Fishery	53,800
1964	36,400	15.4	1967	53,500	10,300	43,200
1965	18,900	10.4	1968	181,700	38,300	143,400
1966	53,800	21.7	1969	159,400	58,400	101,000
1967	43,200	34.0	1970	214,900	82,600	132,300
1968	143,400	52.9	1971	110,800	4,800	106,000
1969	101,000	63.0	1972	248,100	167,600	80,500
1970	132,300	48.2	1973	445,900	281,900	164,000
1971	106,000	33.5	1974	104,100	7,700	96,400
1972	80,500	44.5				
1973	164,000	52.3				
1974	96,400	45.9				

20-22, however, indicated the Big Qualicum return would just meet escapement requirements. Consequently, no additional harvesting of Big Qualicum chums was permitted. The total 1974 return of Big Qualicum chums totalled 104,000, and contributed only 7,700 chums to the 1974 Study Area catch (Table 8).

Analysis of the 1974 Qualicum return indicates that the major brood of 1970 had been adversely effected by unfavourable survival rates during the early marine phase (Table 9). For seven years of flow control prior to 1970, egg-to-fry survival rates averaged 34.0 percent and ranged from 22.5 percent to 50.1 percent. During this same period, fry-to-adult survival rates averaged 0.77 percent and ranged from 0.28 percent to 1.31 percent. For the 1970 brood, the 22.9 percent egg-to-fry survival rate, although less than average, was within recorded ranges. However, the 0.10 percent fry-to-adult survival rate was the lowest recorded to date.

The chum salmon spawning channel at Big Qualicum has been in operation for eight years, during which high egg-to-fry survival rates averaging 73.2 percent have been maintained (Table 10). The spawning channel has produced an average of 19.5 million fry from a spawning of about 17,000 adults. During this same period, production from the river spawning grounds has averaged 27.3 million fry from a spawning of 91,300 adults. Adult production from the spawning channel for years 1967, 1968, and 1969 totalled 41,000, 103,000, and 133,400 respectively. This production, representing fry-to-adult survival rates of 0.35, 0.59, and 0.64 percent respectively, is similar to those rates from the river spawning grounds (Table 11).

Inches and Blaney Creeks

Gravel upwelling incubation units, a relatively new tool in salmon enhancement, have been installed at two sites on the north side of the Fraser River. The facility at Inches Creek, a tributary to Nicomen Slough, was installed in 1970 to develop design and operation criteria for production-scale installations. The facility at Blaney Creek, a tributary to the North Alouette River, was installed in 1972 as a production proto-type. The incubation capacity of the Inches Creek

TABLE 9. Survival of Big Qualicum chum fry, adults and ratio of return-to-escapement (1959-1974).

Brood Year	Total Brood Return	Percent Survival		Ratio of Return-to-Escapement
		Egg-to-Fry	Fry-to-Adult	
1959 ¹	68,800	18.4	0.33	0.70:1
1960 ¹	37,100	5.6	0.82	0.62:1
1961 ¹	17,700	19.8	0.39	1.27:1
1962 ¹	43,900	9.8	0.63	0.93:1
Average				
1959-1962		13.4	0.54	0.88:1
<u>Controlled Flow</u>				
1963	57,900	34.8	0.28	1.53:1
1964	153,900	25.9	1.00	4.23:1
1965	124,700	40.5	1.20	6.60:1
1966	285,300	26.8	1.31	5.30:1
1967	114,500	50.1	0.34	2.65:1
1968	322,500	22.5	0.61	2.26:1
1969	406,600	37.2	0.65	4.03:1
1970 ²	46,700	22.9	0.10	0.35:1
1971		19.6		
1972		37.5		
1973		23.0		
1974		32.9		
Average				
1963-1974		31.1	0.69	3.37:1

¹ Commercial catch not included.

² Incomplete, five year old contingent returns in 1975.

TABLE 10. Big Qualicum spawning channel chum fry production (1967-1974).

Brood Year	Total Spawning	Total Females Spawning	Egg Deposition (Millions)	Fry Produced (Millions)	Percent Survival Egg-to-Fry
1967	8,270	4,590	14.5	11.6	80.0
1968	15,760	7,030	22.4	17.5	78.1
1969	16,640	8,740	27.1	20.9	77.1
1970	20,290	11,420	32.0	20.5	64.1
1971	17,040	9,240	25.4	17.5	68.9
1972	19,060	11,600	33.6	22.5	66.9
1973	18,100	10,310	31.9	24.2	75.9
1974	21,110	9,930	28.6	21.4	74.8
Average	17,030	9,110	26.9	19.5	72.5

TABLE 11. Survival of Big Qualicum spawning channel adults and ratio of return-to-escapement (1967-1970).

Brood Year	Total Brood Return	Percent Survival Fry-to-Adult	Ratio of Return-to-Escapement
<u>Spawning Channel</u>			
1967	41,000	0.35	4.96:1
1968	103,000	0.59	6.55:1
1969 ¹	133,400	0.64	8.02:1
1970 ¹	12,000	0.06	0.59:1
<u>River</u>			
1967	73,500	0.33	2.10:1
1968	322,500	0.62	1.72:1
1969 ¹	273,200	0.65	3.24:1
1970 ¹	34,700	0.13	0.31:1

¹ Incomplete, five year old contingent returns in 1975.

installation is 1.0 million chum salmon eggs, and the Blaney Creek installation, 1.5 million. Present plans include the expansion of each installation to 6.0 million eggs.

Each incubation unit (Fig. 4), constructed of timber reinforced plywood, is designed to incubate 0.5 million chum salmon eggs. These units, relatively inexpensive to build and of a modular style design, can be installed on a temporary or permanent basis in single or multiple units. In addition, the

installation-site and water requirements for the units are relatively small. These characteristics are a definite advantage in such areas of high land costs and/or limited water supply.

The units employ the principle of incubating eggs in gravel through which upwelling water flows. Eggs, fertilized and water hardened, are layer-planted within an hour of collection, directly into the incubation units. The water, usually gravity supplied, is delivered to a false bottom in the unit and upwells through alternating layers of gravel and eggs. Emergent fry migrate voluntarily to the receiving stream.

The incubation units have been in operation at Inches Creek for five years, and at Blaney Creek for three years. During these periods, exceptionally high egg-to-fry survival rates averaging 83.5 and 92.2 percent, for the two sites respectively, have been maintained. (Table 12).

A chum fry marking program has been carried out annually since 1972 on the incubation unit production at Blaney Creek. To date, 700,000 fin-marked fry have been released. The recovery of the marked adults will aid in evaluating the production performance of these units in terms of their contributions to the fisheries.

Chum salmon returning in 1974 to Inches Creek included three and four year old adults from the 1970 and 1971 incubation unit production. Since these fry were not marked, it was not possible to evaluate their production. The magnitude of the 1974 return, however, indicates a substantial production. Chums returning to Inches Creek have, since 1949, ranged from 200 to 3,500 and averaged 1,800. In 1974, an estimated 8,000 chums returned.

Future expectations of chum salmon production from incubation units are very good. On the basis of the survival data presented in Table 12, the apparent successful return of adults, and the characteristic advantages of installation, the gravel upwelling incubation units are a desirable tool in the scheme of salmon enhancement.

TABLE 12. Inches and Blaney Creeks chum fry production (1970-1974).

Location	Brood Year	Females Used	Egg Deposition (Thousands)	Fry Produced (Thousands)	Percent Survival Egg-to-Fry	Fry Marked (Thousands)
Inches Cr.	1970	201	464	323	69.6	
	1971	356	921	882	95.9	
	1972	294	793	713	89.9	
	1973	286	772	663	85.8	
	1974	437	1,265	940	74.4	
Average			843.0	704.2	83.5	
Blaney Cr.	1972	110	265	257	97.7	257
	1973	523	1,385	1,282	92.6	253
	1974	85	226	191	84.5	190
Average			625.3	576.7	92.2	

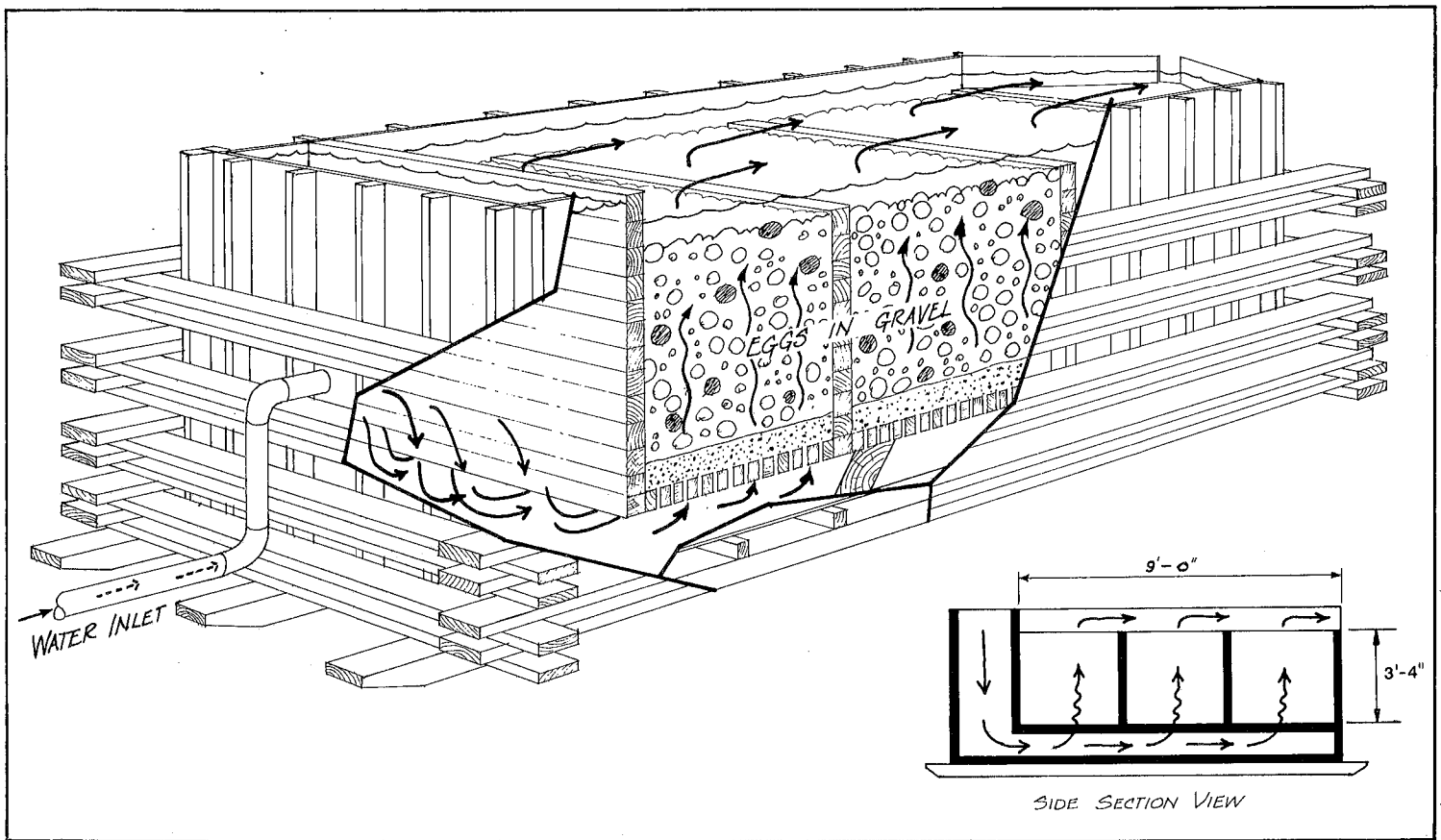


Figure 4. Schematic diagram of the Inches and Blaney Creeks gravel upwelling incubation units.

The 1975 Season

Prospects for the 1975 Level of Abundance

The 1975 chum salmon return to the Johnstone Strait-Fraser River Study area will consist of age five fish from the 1970 escapement of 1,157,000, age four fish from the 1971 escapement of 721,200, and age three fish from the 1972 escapement of 1,971,700. In a typical return, four year old chums are generally the major component of the return. The major component of the 1975 return will be produced from the low 1971 escapement of 721,200. On this basis alone, the 1975 return is expected to be low.

A forecast of production rates from the three contributing brood years has been made (Append. E). In addition, an apparent relationship has existed between the return of age three fish in one year and the return of age four and five fish in the subsequent years. The proportion of age three fish returning from each brood year has been calculated for the years 1960 to 1971 (Table 7). On the basis of these relationships, the brood year production by age of return can be calculated.

In the following, separate projections have been made for the Big Qualicum River stock.

(a) Magnitude of the Age Five Return

The 1970 escapement has produced 1,083,300 age three and four fish. This number is indicative of a poor survival from the 1970 escapement. The proportion of age five fish produced from a brood year has ranged from 1.3 percent to 16.7 percent (Table 7). Based on the low returns to date, the production of age five fish is anticipated to be the minimum proportion of 1.3 percent.

Accordingly, the age five component of the 1975 return has been projected at 13,600 chum salmon.

(b) Magnitude of the Age Four Return

A return-to-escapement of 1.62:1 has been forecast for the 1971 brood (Append. E). The return of age three chums in 1974 totalled 375,500. On the basis of the production forecast, this number implies a near maximum production of age three fish. In the four other recorded broods of 1960, 1961, 1963 and 1965, when the production of age three fish was maximum, averaging 36.4 percent, the age five production was minimum, averaging 2.4 percent. On this basis, the majority of the outstanding brood production will return in 1975. Accordingly, the age four component of the 1975 return has been projected at 609,900 chum salmon.

(c) Magnitude of the Age Three Return

A return-to-escapement of 2.01:1 has been forecast for the 1972 brood (Append. E). On this basis, and assuming the current four year average of 12.7 percent age three production, the age three component of the 1975 return has been projected at 482,800 chum salmon. This projection, based on the current four year average, may be low. Returns to date, as outlined previously, suggest that the proportion of age three production may revert to former brood year levels. On this basis, the age three component could be doubled. This possibility, however, will not be known until an age analysis is obtained from the early chum salmon catches in Johnstone Strait.

(d) Magnitude of the Fraser River Stock

The 1975 return to the Fraser River, included in the preceding projections, will total 506,000 chum salmon. This return has been calculated using the ratios of Fraser to non-Fraser escapements and the preceding projections.

(e) Magnitude of the Big Qualicum River Stock

In addition to the preceding projections, the Big Qualicum River stock returning in 1975 has been projected at

243,000 chum salmon. This projection has been based on the average fry-to-adult survival rate and age class production recorded for broods 1963 to 1970.

(f) Forecast for the 1975 Return

The total return in 1975 to the Johnstone Strait-Fraser River Study Area has been projected at 1,349,300 chum salmon. The expected age composition of this return is 1.5 percent age five, 59.6 percent age four, and 38.9 percent age three chums.

MANAGEMENT PROPOSALS FOR 1975

In past years, Study Area escapements in the order of 2.0 million have provided maximum catches. Since 1960, annual escapements have averaged 1.1 million, which produced an average annual return of 1.7 million. The expected return of 1.3 million chum salmon in 1975 represents little rehabilitation over recent brood year levels, and consequently, will require substantial protection. Protection of the weaker stocks will have to be emphasized to obtain a minimum acceptable escapement. At the same time, exploitation will be allowed on those stocks expected to return in a fishable abundance.

The protection required for the weak stocks of the Upper Vancouver Island, Kingcome Inlet, Bond to Knight Inlets, and the Johnstone Strait sub-areas can be accomplished by the closures of Goletas Channel and the Mainland Inlets of Area 12, with no specific late-season Nimpkish chum fishery.

The protection required for the other weak stocks of the Loughborough to Bute Inlet, Lower and Southern Vancouver Island, and Howe Sound sub-areas can only be accomplished by a reduction of fishing times in Johnstone Strait.

Exploitation of those stronger stocks, particularly the Big Qualicum stock, will have to be accomplished by local fisheries to supplement the exploitation in Johnstone Strait.

Accordingly, with these facts under consideration, the following major regulatory proposals for 1975 are presented.

Proposed Fishing Pattern

(a) Areas 12 and 13

Week Ending	Days Fishing
September 20	0
September 27	0
October 4	2
October 11	0
October 18	0
October 25	2
November 1	0
November 8	0
November 15	Closed for the Season

It is also proposed that:

- i) Goletas Channel be closed effective September 14 until further notice. This closure would include those southwesterly waters bounded at the northwest from Cape Sutil to Mexicana Point, along the southerly shores of Hope and Nigei Islands, and at the southeast from Boxer Point to the Vancouver Island shore immediately opposite.
- ii) The returns to the Mainland Inlets of Areas 12 and 13 are expected to be below escapement requirements. Accordingly, it is proposed that the normal Fall

boundaries closing the Mainland Inlets be in effect September 14.

It is anticipated the proposed regulations will provide a catch of about 170,000 chum salmon.

(b) Area 14

Chum salmon returning to Big Qualicum will be in maximum abundance in Area 12 during the week ending October 25, and in Area 14, during the week ending November 22. Should the Big Qualicum stock return in the expected abundance, fishing in designated portions of Area 14 will be permitted during November to ensure adequate harvesting. The Big Qualicum escapement requirement is 125,000 chums. It is anticipated that 94,000 chums will be harvested in Area 14. Fishing times and boundaries will be announced at a later date.

(c) Areas 15, 16, 17 and 18

Stocks returning to these areas are expected to be weak. No local fisheries are proposed.

(d) Area 29

Chum salmon returning to the Fraser River will be present in Area 12 from mid-September to early November, and in maximum abundance during the later part of October. The escapement requirements for the Fraser River have been estimated at 500,000 to 600,000 chum salmon. It is apparent from the expected return that the desired escapement cannot be achieved. It is anticipated, however, that chums returning to the Stave River, an early run, and the late runs to the Harrison River, and perhaps to Weaver and Inches Creeks, will be in fishable abundance. Fishing times will be announced after October 12, when the International Pacific Salmon Fisheries Commission relinquishes control, if these runs, as indicated by test-fishing, warrant harvesting.

In summary, the proposed fishing pattern, for the projected abundance of 1,349,300, will provide a catch of about 340,000 from the stronger stocks and provide an escapement to the Study Area of about 1,009,000 chum salmon. An escapement of this order, although less than desired, does represent a measure of rehabilitation over the major brood year escapement of 721,000 chum salmon.

Chum salmon abundance in Johnstone Strait and the Fraser River will be assessed continuously throughout the season. If the stocks return in greater strength than projected, particularly the age three component, additional fishing times will be granted consistent with attaining adequate escapement. Likewise, the proposed fishing will be reduced if, during the progress of the fishing season, the proposed closures are deemed insufficient to provide a minimum acceptable escapement.

APPENDIX A

Major regulations and fishing effort by statistical area and week during the 1974 chum season.

Week Ending	Days Fishing	Number of		Major Regulations by Week Ending
		Gill-nets	Seines	
Statistical				Area 12
September 14	2	157	146	Goletas Channel and Mainland Inlets closures previously in effect U.F.N. Extended Nimpkish River boundary in effect U.F.N. ¹
September 21	0	0	0	Closed to salmon net fishing.
September 28	0	0	0	Closed to salmon net fishing.
October 5	2	161	131	Adams River straight line, Keogh and Cluxewe River boundaries in effect U.F.N..
October 12	0	0	0	Closed to salmon net fishing.
October 19	0	0	0	Closed to salmon net fishing.
October 26	2	229	262	Goletas Channel opened.
November 2	0	0	0	Closed to salmon net fishing for balance of the season.
Statistical				Area 13
September 14	2	34	54	Mainland Inlets, including Bute Inlet, closures previously in effect U.F.N.
September 21	0	0	0	Closed to salmon net fishing.
September 28	0	0	0	Closed to salmon net fishing.
October 5	2	66	80	Bear River extended boundary in effect U.F.N.
October 12	0	0	0	Closed to salmon net fishing.
October 19	0	0	0	Closed to salmon net fishing.
October 26	2	274	87	
November 2	0	0	0	Closed to salmon net fishing for balance of the season.
Statistical				Area 14
October 26	0	0	0	Closed to salmon net fishing previously in effect U.F.N.
November 2	1	191	16	Opened to salmon net fishing in that portion two miles seaward from two miles west of Little Qualicum, to Sisters Island, to Finnerty Light, to Point Young, and then to Dorcas Point.
November 9	0	0	0	Closed to salmon net fishing for balance of the season.
Statistical				Area 17
October 26	0	0	0	Closed to salmon net fishing previously in effect U.F.N.
November 2	1	262	29	Opened to salmon net fishing in that portion westerly of Dorcas Point, Ballenas Islands, to Thrasher Rock. Nanaimo River boundary from Horsewell Bluff to Decanso Point, Nanoose Bay closed.
November 9	0	0	0	Closed to salmon net fishing for balance of the season.

APPENDIX Con't

	Statistical	Area 29	
October 5	1	848	— I.P.S.F.C. regulations.
October 12	0	0	— Closed to salmon net fishing.
October 19	0	0	— Closed to salmon net fishing.
October 26	1	439	— Area 29D remained closed.
November 2	0	0	— Closed to salmon net fishing.
November 9	1	831	— All of area opened.
November 16	0	0	— Closed for balance of the season.

I U.F.N. = until further notice

APPENDIX B

Early-season chum catches in Johnstone Strait
and Study Area total return.

An examination of early-season chum salmon catches in Johnstone Strait has been made to test the hypothesis that a relationship of predictive value exists between these catches and the total return to the Study Area. This examination indicates a useable relationship does exist. Since the fishing started up again in 1967, when the catches in Johnstone Strait during September were low, for example, the total return to the Study Area was also low. The inverse was also true.

The catches, as reported on sales slips as occurring during the first two days of a fishery, from Areas 12 and 13 during the first, second, and third weeks of September and their relationship to the recorded Study Area return for years 1967 to 1974, are listed in Table B1. Only three fisheries occurred during the fourth week of September and were insufficient for analysis.

The better correlations between catch and return were found in the combined catches of Areas 12 and 13.

Cumulative catches to date did not improve the correlations. The calculated linear regressions, where y = the return in thousands and x = the catch in thousands, for the combined catches on a weekly basis, indicated a significance at the 0.05 level or better and a correlation of regression of 0.84 or better. Based on these best correlations, the magnitude of errors encountered in "predicting" the return averaged 32 percent of the first week of September, 22 percent for the second, and 12 percent for the third week.

In 1974, based on the projected Study Area return of 1,554,000 chum salmon, the catch in Areas 12 and 13 during the fishery of September 8-10 was anticipated to be in the order of 6,000 to 8,000. The recorded catch of about 11,400 indicated a return of about 1,806,000. The return for 1974 has been recorded at 1,796,800.

In 1975, based on the projected return of 1,349,300, the early-season chum salmon catches in Areas 12 plus 13 for two day fisheries during the first, second, and third weeks of

TABLE B1. Early-season chum salmon catches in Johnstone Strait and their relationship to the total return to the Study Area (1967-1974).

Year	Total Return	First Week Ending	Catches* During Weeks of September								
			Area 12			Area 13			Areas 12 & 13		
			First Week	Second Week	Third Week	First Week	Second Week	Third Week	First Week	Second Week	Third Week
1967	904,000	Sept. 9	1,680	2,138	2,510	312	979	819	1,992	3,117	3,329
1968	2,740,500	Sept. 6	11,529	12,915	-	1,839	3,965	-	13,368	16,880	-
1969	1,678,700	Sept. 7	2,106	6,817	11,623	837	2,100	6,616	2,943	8,917	18,239
1970	2,182,200	Sept. 6	9,797	17,181	32,385	589	4,390	7,358	10,386	21,571	39,743
1971	837,400	Sept. 4	2,022	2,529	7,230	118	250	2,541	2,140	2,779	9,771
1972	3,907,900	Sept. 9	7,875	24,265	62,914	1,304	7,094	23,590	9,179	31,359	86,504
1973	4,717,200	Sept. 8	36,826	54,981	63,339	2,700	15,361	30,865	39,526	70,342	94,204
1974	1,796,800	Sept. 7	-	10,157	-	-	1,279	-	-	11,436	-
Statistics											
Correlation of Regression			0.82	0.92	0.98	0.90	0.93	0.99	0.84	0.92	0.99
Level of Significance			0.05	0.005	0.005	0.01	0.005	0.005	0.05	0.005	0.005
Equation of Linear Regression			97.8X + 1420.5	73.5X + 1142.3	56.7X + 668.9	1438.0X + 842.4	259.3X + 1197.9	129.2X + 825.2	93.0X + 1367.1	57.4X + 1150.9	40.2X + 684.4
Average Percent Difference Between Predicted and Record Pattern			34	22	16	24	24	11	32	22	12

* First two-day net catch as recorded on sales slips.

APPENDIX Con't

September, are anticipated to be about:

Week Ending	Catch
September 6	— to 4,500
September 13	— to 8,600
September 20	12,500 to 20,600

Some caution must be exercised in the use of this catch-return relationship. In addition to being based on final catch figures, it also assumes that the escapement and/or rate of return of early timing stocks are in proportion to those of later timing.

APPENDIX C

Johnstone Strait chum salmon test-fishing.

Test-fishing, during periods of low chum salmon abundance, has been conducted in upper Johnstone Strait since 1965. This monitoring program is conducted during closed weekly fishing periods to obtain information, normally obtained from the weekly fishing, on the relative abundance of chums entering the Study Area.

The test-fishing procedures, developed during the combined test and tagging operations of 1965-1970, involve fishing in established locations with standardized methods. In total, fifteen test-fishing locations have been established (Fig. C1) along the approach route of chums migrating through Johnstone Strait. These locations are test-fished in accordance to the prevailing weather at a stage of tide at which they would be fished during a regular fishery. During each weekly testing, a daily minimum of three locations are fished.

The weekly average test-catch and number of sets made during the 1974 operation and those of previous years for similar periods are summarized in Table C1. Test-fishing has generally been conducted during years of low abundance. During these years, the total return has averaged about 1.5 million annually. The weekly catches listed under "All Years" do not exceed 400, and would be characteristic of those weekly abundances that could be expected during a year of which the return was about 1.5 million. During 1969 and 1974, when the return exceeded 1.5 million, but was less than 2.0 million, the average test-catches for at least two weeks were about 400 or greater. During 1968 and 1970, when the return exceeded 2.0 million, the average test-catches for at least two weeks exceeded 600.

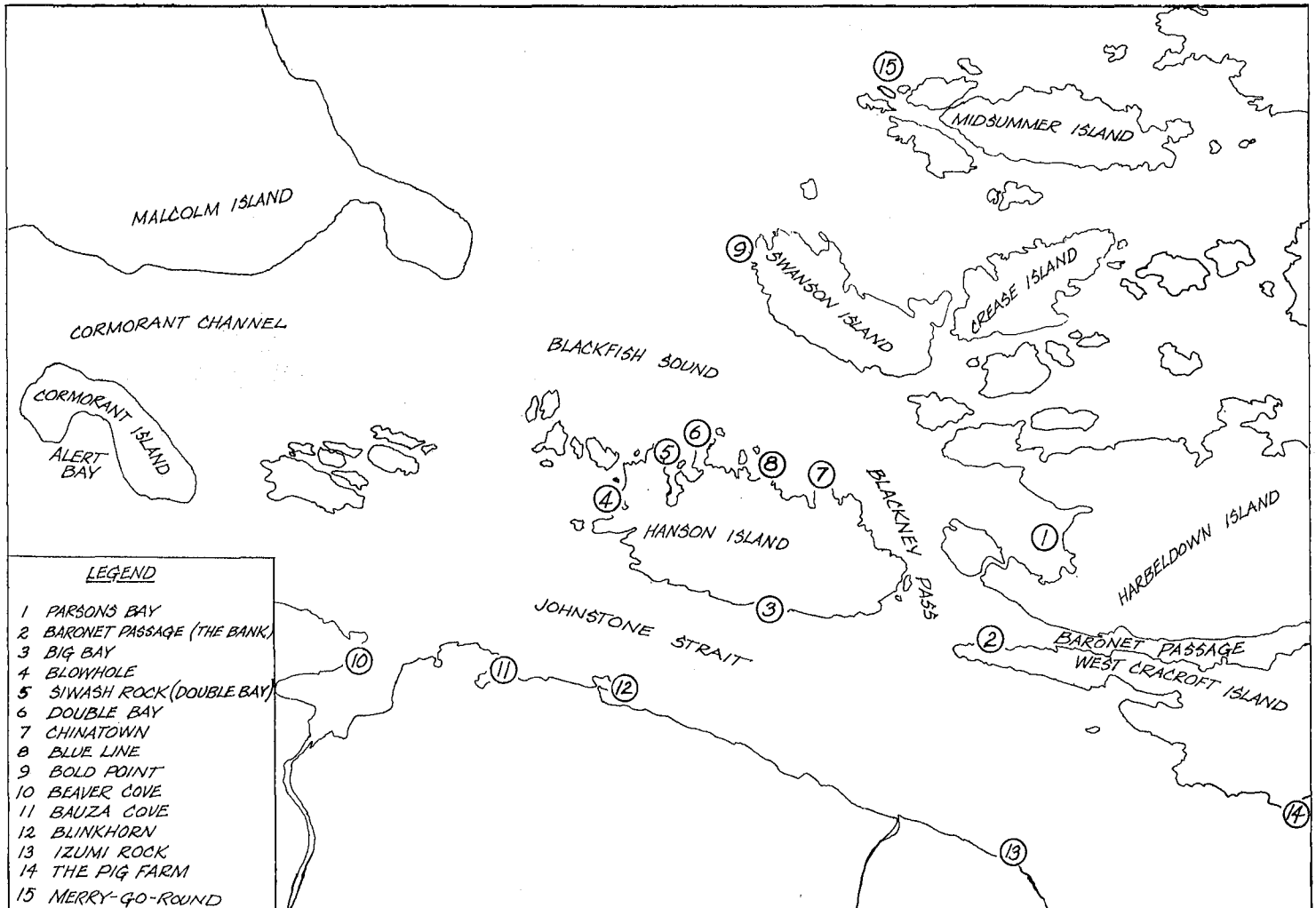


Figure C1. Chum salmon test-fishing locations in upper Johnstone Strait.

TABLE C1. Average weekly catches of chum salmon and sets made in the upper Johnstone Strait test-fishing program during 1974 and those for similar periods during 1965-1971¹.

Week Ending	Average Catches and Number of Sets in Brackets								
	1965	1966	1967	1968	1969	1970	1971	1974	All Years
<u>To</u>									
Sept. 21	-	24	-	-	-	-	-	48	43
	-	(7)	-	-	-	-	-	(27)	(34)
Sept. 28	21	47	11	1,088	217	48	-	128	180
	(3)	(4)	(9)	(4)	(7)	(6)	-	(19)	(70)
Oct. 5	75	21	178	1,144	174	805	38	432	263
	(4)	(6)	(4)	(4)	(5)	(2)	(14)	(9)	(48)
Oct. 12	9	62	19	500	359	768	104	394	309
	(4)	(4)	(9)	(14)	(9)	(8)	(15)	(13)	(76)
Oct. 19	28	55	599	225	466	-	211	627	385
	(6)	(3)	(10)	(11)	(9)	-	(15)	(19)	(73)
Oct. 26	70	550	94	283	394	-	22	107	178
	(4)	(2)	(4)	(3)	(9)	-	(12)	(5)	(39)
Nov. 2	81	49	214	19	45	-	14	198	85
	(5)	(7)	(6)	(7)	(10)	-	(20)	(16)	(71)
<u>From</u>									
Nov. 9	72	46	15	230	30	-	22	-	49
	(5)	(4)	(8)	(4)	(5)	-	(17)	-	(43)
Total Return (Millions)	0.44	1.04	0.90	2.74	1.68	2.18	0.84	1.80	1.45

¹ No test fishing was conducted in 1973 and only one week in 1972.

APPENDIX D

Chum salmon escapements in thousands of fish, recorded by
stream and totalled by sub-area (1964-1974).

STREAM	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974
<u>UPPER VANCOUVER ISLAND</u>											
Cluxewe	1.50	.20	.20	.75	1.50	.20	.20	.20	.10	.43	.40
Keogh	3.50	1.50	.75	.75	3.50	3.50	1.50	.20	1.50	.70	.40
Nahwitti	.40	.20	.75	-	-	-	.75	-	-	-	-
Quatse	7.50	7.50	1.50	.40	7.50	.75	.75	.08	2.50	.60	.40
Stranby	-	-	-	-	-	.75	.75	-	-	-	-
Tsulquate	.75	.03	.08	.02	3.50	.40	.20	.05	.55	.43	.50
Totals	13.65	9.43	3.28	1.92	16.00	4.85	4.15	.53	4.65	2.16	1.70
<u>KINGCOME INLET</u>											
Embly	-	3.50	-	1.50	-	-	.40	.20	-	-	-
Kingcome	15.00	3.50	7.50	15.00	15.00	3.50	15.00	1.50	35.00	40.00	45.00
McKenzie	.20	.75	1.50	3.50	3.50	3.50	3.50	3.50	7.00	15.00	5.00
Nimmo	.20	.20	3.50	1.50	1.50	1.50	3.50	.75	1.50	6.00	5.00
Tsibass	.20	.03	.75	.20	.20	.20	1.50	-	.40	6.00	-
Wakeman	3.50	.75	.75	-	1.50	-	.40	.40	8.00	20.00	8.00
Totals	19.10	8.73	14.00	21.70	21.70	8.70	24.30	6.35	51.90	87.00	63.00
<u>BOND TO KNIGHT</u>											
Ahnuhati	15.00	.75	.75	7.50	3.50	3.50	3.50	1.50	3.50	4.00	1.00
Ah-Ta-Valley	.40	.08	.08	1.50	.20	.75	.40	.20	.40	1.50	-
Franklin	.75	.75	.40	-	.40	-	-	-	.75	.75	.75
Glendale	60.00	.08	15.00	35.00	15.00	1.00	35.00	.40	15.00	40.00	2.00
Kakweiken	3.50	.75	.75	3.50	3.50	3.50	1.50	.40	7.50	8.00	-
Klini-Klini	15.00	1.50	3.50	.75	.75	.08	7.50	.75	25.00	30.00	7.50
Shoal	3.50	.40	.20	1.50	.20	.20	.03	.75	3.50	4.00	1.00
Viner	35.00	1.00	.40	35.00	35.00	50.00	30.00	7.50	35.00	60.00	40.00
Washilas	.75	.03	-	.03	.20	.03	-	-	-	-	-
Waterfall	15.00	.20	7.50	7.50	15.00	15.00	15.00	.20	25.00	30.00	10.00
Totals	148.90	5.54	28.58	92.28	73.75	74.06	92.93	11.70	115.65	178.25	62.25
<u>JOHNSTONE STRAIT</u>											
Adam-Eve	.75	.20	1.50	.75	-	-	-	-	.75	-	-
Fulmore	.75	.75	1.50	-	-	1.50	1.50	.40	4.00	2.00	1.00
Hyacinth	1.50	.40	3.50	3.50	3.50	1.50	1.50	.50	6.50	3.50	1.50
Kokish	.08	.20	.08	.20	.08	.03	.08	-	.08	.50	.30
Nimpkish	15.00	15.00	35.00	15.00	55.00	7.50	18.00	7.50	20.00	25.00	5.00
Robbers Nob	.03	.03	.03	-	.03	-	-	-	-	-	-
Salmon	.75	.40	3.50	1.50	.75	.40	1.50	.75	.75	.75	.75
Tsitika	.20	-	.08	-	-	-	-	-	.40	.30	-
Totals	19.06	16.98	45.19	20.95	59.36	10.93	22.58	10.15	32.48	32.05	8.55
<u>LOUGHBOROUGH TO BUTE</u>											
Armour de Cosmos	.40	.08	.20	.75	.75	.20	1.50	.20	.40	3.50	.75
Apple	1.50	.40	.20	.40	3.50	1.50	20.00	5.00	3.50	15.00	5.00
Cumsack	-	-	.75	.08	-	-	.03	-	-	-	-
Heydon	15.00	.75	7.50	15.00	35.00	7.50	75.00	7.50	35.00	35.00	10.00
Homathko	7.50	.40	3.50	3.50	3.50	.20	3.50	1.50	75.00	7.50	7.50
Orford	7.50	6.00	1.50	3.50	18.00	7.50	3.50	.75	35.00	100.00	15.00
Phillips	7.50	.75	1.50	1.50	7.50	1.50	3.50	.75	7.50	15.00	3.50
Southgate	15.00	2.00	7.50	7.50	15.00	7.50	7.50	3.50	75.00	35.00	35.00
Stafford-Fraser	1.50	.08	.20	3.50	3.50	1.50	1.50	1.50	.75	3.50	3.00
Village Bay	.75	.75	1.50	.40	3.50	.75	1.50	.40	3.50	.75	1.50
Totals	56.65	11.21	24.35	36.13	90.25	28.15	117.53	21.10	235.65	215.25	81.25
<u>MID-VANCOUVER ISLAND</u>											
Campbell-Quinsam	.75	.40	.75	.75	.75	3.50	3.50	1.50	3.50	5.00	3.90
Cook	1.50	.20	1.50	1.20	6.50	.90	5.00	1.30	7.50	4.00	5.00
Cougar	.75	.20	.75	1.00	1.50	.35	.30	.20	.70	.50	.20
Englishman's	1.50	1.50	7.50	.50	6.00	7.50	3.50	3.50	15.00	7.50	5.00
French	.20	.03	1.50	.10	1.00	1.50	.03	.03	3.50	.40	.25
McNaughton	1.50	.08	.40	.30	.25	.15	4.50	1.10	1.50	1.80	2.50
Nile	.20	.08	.08	.05	.40	.20	.03	.03	.40	.07	.02
Oyster	.40	.08	.20	.05	.80	.25	.20	.10	.85	.25	.50
Puntledge	35.00	1.50	35.00	20.00	55.00	27.50	34.00	14.50	60.00	55.00	45.00
Big Qualicum	36.40	18.90	53.85	43.20	143.40	101.00	132.30	106.00	80.30	163.95	96.40
Little Qualicum	35.00	15.00	35.00	40.00	85.00	75.00	104.77	35.00	50.00	75.00	65.00
Rosewall	.75	.20	1.50	2.50	6.00	1.40	2.00	.60	3.00	2.65	.80
Tsable	7.50	1.50	7.50	7.00	21.00	11.50	7.00	1.10	16.00	3.50	6.00
Tsolum	.75	.08	-	.20	5.00	.50	.20	-	-	-	.05
Waterloo	.40	.20	.40	.40	1.20	.15	.35	.10	.40	.80	.50
Wilfred (Coal)	.75	.08	.40	.90	2.50	1.00	1.00	.30	4.00	.95	1.50
Totals	123.35	40.03	146.33	118.15	336.30	232.40	298.68	165.36	246.65	321.37	233.12

APPENDIX Con't

STREAM	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974
<u>TOBA INLET</u>											
Brem	.75	.75	.40	1.50	5.00	3.00	.50	4.00	5.00	1.00	.20
Forbes	.75	.20	.75	.50	.60	.50	.50	.40	1.00	.10	4.00
Klite	1.50	3.50	3.50	2.00	10.00	.50	1.00	3.00	1.80	1.50	.01
Okeover	.40	.40	.75	.60	3.00	2.20	.40	.20	3.00	.70	.50
Quatum	1.50	.40	.20	.40	3.50	1.50	1.50	.40	4.50	3.50	3.50
Salt Lagoon	.03	.03	.03	.20	.40	.20	.05	.05	-	.05	-
Theodosia	3.50	3.50	7.50	2.00	20.00	8.00	2.20	2.00	15.00	2.30	7.00
Toba	7.50	7.50	7.50	8.00	20.00	2.00	2.00	10.00	14.00	1.00	12.00
Little Toba	.75	.08	.75	3.00	15.00	1.00	1.50	3.00	6.00	1.00	-
Totals	16.68	16.36	21.38	18.20	77.50	18.90	9.65	23.05	50.30	11.15	27.21
<u>JERVIS INLET</u>											
Angus (Pete)	3.00	.40	1.50	.20	3.00	4.00	.42	.10	2.00	3.00	.50
Brittain	.03	.08	.20	.01	.10	3.00	.15	-	1.00	.10	.50
Chamberlain	.40	.75	1.50	.10	.50	3.00	.20	.01	1.00	.50	.20
Deserted	3.50	.75	.75	4.00	20.00	12.00	30.00	10.00	30.00	30.00	25.50
Mouat Bay						6.00	.20	2.00	.20	-	.01
Pender Harbour	1.50	.75	.75	.80	12.00	5.50	3.20	2.50	16.00	16.00	15.00
Sakinaw Lake	.75	.20	.08	.10	.30	1.00	.10	.05	.10	.20	.30
Saltery Bay (Murphy)	7.50	7.50	7.50	5.00	15.00	18.00	16.00	7.00	8.00	14.00	9.00
Shannon	.75	.03	.40	.02	1.00	3.00	.10	.02	.50	.20	-
Siwash	-	.03	-	.40	-	-	-	-	.01	-	-
Skwawka	1.50	.08	.40	.05	3.00	3.00	6.50	3.00	8.00	1.00	3.00
Sliamon	7.50	1.50	3.50	.60	9.00	8.00	4.00	3.00	3.50	7.00	5.00
Snake	.40	.08	.75	.60	1.50	2.00	.05	.01	.40	.05	.05
Thunder Bay	.20	.20	.40	.05	.15	.15	.40	.30	.20	.40	1.00
Tzoonie	15.00	3.50	7.50	5.00	20.00	21.00	1.20	11.00	12.00	11.00	25.00
Vancouver	.07	.03	.40	.10	2.20	1.00	1.20	.50	2.50	8.00	4.50
Wolfson	3.50	.75	1.50	.40	6.00	4.00	1.20	1.20	3.00	1.00	1.00
Totals	45.60	16.63	27.13	17.43	93.75	96.65	64.92	40.69	88.41	92.45	90.56
<u>LOWER VANCOUVER ISLAND</u>											
Bonsall	.08	.08	.75	.10	.10	.10	.17	.20	.45	.27	.60
Bush	3.50	.75	3.50	1.30	3.00	3.43	6.75	1.50	6.60	2.65	2.20
Brunnell	.40	3.50	1.50	.50	4.15	6.75	2.35	2.35	3.00	8.50	.95
Holland (103rd)	7.50	1.50	7.50	3.10	7.60	5.25	7.50	1.95	10.25	3.70	.57
Nanaimo	15.00	15.00	75.00	22.00	26.00	26.00	30.00	17.50	70.00	36.00	38.00
Nanoose	.75	.20	1.50	.25	2.00	3.23	2.80	2.80	11.60	13.00	6.50
Stocking Lake	1.50	1.50	3.50	1.50	2.86	3.15	6.75	5.55	2.20	2.20	1.30
Walkers	.07	.20	.40	.20	.47	.13	.12	.65	.25	.04	.50
Totals	28.80	22.73	93.65	28.95	46.18	48.04	56.44	32.50	104.35	66.36	50.62
<u>SOUTHERN VANCOUVER ISLAND</u>											
Chemainus	3.50	7.50	35.00	12.00	12.00	8.00	3.75	3.00	24.50	24.00	20.50
Cowichan	35.00	35.00	75.00	75.00	100.00	75.00	35.00	15.00	90.00	75.00	75.00
Goldstream	7.50	12.00	9.80	7.00	7.50	8.00	7.50	3.50	3.50	7.50	7.50
Koksilah	3.50	3.50	7.50	3.50	3.50	3.50	1.50	1.50	4.00	5.00	5.00
Totals	49.50	58.00	127.30	97.50	123.00	94.50	47.75	23.00	122.00	111.50	108.00
<u>HOWE SOUND</u>											
Cheakamus	15.00	3.50	15.00	20.00	30.00	20.00	25.00	4.50	60.00	50.00	35.00
Mamquam	3.50	.40	.20	.30	2.50	10.00	25.00	3.50	45.00	45.00	25.00
Squamish	15.00	3.50	3.50	20.00	70.00	18.00	50.00	15.00	200.00	120.00	70.00
Totals	33.50	7.40	18.70	40.30	102.50	48.00	100.00	22.50	305.00	215.00	130.00
<u>BURRARD INLET</u>											
Indian	5.00	3.50	3.50	3.50	15.00	15.00	15.00	7.50	35.00	35.00	7.50
<u>FRASER RIVER</u>											
Alouette N.	.40	.20	.40	.07	.40	.20	.40	.75	.75	3.50	1.30
Alouette S.	.75	.20	3.50	.40	3.50	.40	.75	1.50	7.50	7.50	4.50
Blaney	.75	.40	.40	.40	.75	.40	.20	.75	.75	1.50	.45
Bouchier	.20	.28	.75	.02	.40	.40	.20	.07	.40	.40	.07
Chehalis	13.00	12.00	26.00	13.00	60.00	43.10	15.00	35.00	35.00	52.00	52.20
Harrison	89.00	47.00	165.00	67.00	229.00	102.90	117.10	116.45	144.00	52.00	111.80
Inches	.75	1.80	3.00	3.50	3.50	3.00	2.40	1.50	.40	1.50	7.40
Kanaka	.07	.08	.40	.20	.07	.03	.40	.40	1.50	3.50	1.00
Nicomien	.75	.75	3.50	.75	.40	.75	1.50	1.50	.40	.40	.75
Norrish (Suicide)	.05	3.50	7.50	.40	7.50	3.50	1.50	.75	5.00	.75	1.50
Squakum	6.00	5.00	13.00	16.00	32.00	12.10	6.90	7.50	24.00	19.00	8.80
Stave	37.00	26.00	80.00	19.00	157.00	75.00	66.10	45.70	53.00	27.00	63.70
Vedder-Chilliwack*	96.00	32.00	58.00	87.00	168.00	52.30	62.40	71.35	110.00	55.00	57.30
West	.03	.03	.40	.20	.50	.03	.20	.20	.20	.20	.30
Whonnock	.30	.20	.40	.40	1.50	1.50	1.50	.40	.40	1.50	1.50
Weaver	.75	3.50	3.70	1.50	3.50	10.50	1.50	1.50	35.00	26.00	35.00
Worth	.20	.02	.40	.07	.02	.08	.03	.40	-	-	-
Mainstem Fraser	79.00	52.04	63.65	2.09	154.00	83.91	25.00	71.00	161.40	201.25	217.73
Totals	325.00	185.00	430.00	212.00	822.04	390.10	303.08	356.72	579.70	453.00	565.30
Grand Totals	884.79	401.54	983.39	709.01	1,877.33	1,070.28	1,157.01	721.15	1,971.74	1,820.54	1,429.06

* Includes Sweltzer

APPENDIX E

Pink and chum salmon production in the Johnstone Strait-Fraser River area (1956-1972).

An examination of pink salmon production has been made to test the hypothesis that a relationship of predictive value exists between this production and that of chum salmon of the same brood year. This examination indicates a useable relationship does exist. When the production of pink salmon is below average, for example, the production of chum salmon of the same brood year will also be below average. The inverse was also true (Fig. E 1).

The production of pink and chum salmon has been expressed as a ratio of return-to-escapement. For example, in 1967 1,831,000 and 379,900 pink salmon spawned in the Fraser River and Johnstone Strait areas respectively for a total area escapement of 2,210,900. In 1969, pink salmon returning to these areas totalled 4,187,900, and represented a ratio of return-to-escapement of 1.89:1. The return of age three, four and five year old chum salmon from the 1967 Study Area escapement of 709,000 totalled 659,000, and represented a ratio of return-to-escapement of 0.93:1 (Table E1).

A linear regression of these data indicated a level of significance at the 0.005 level and a correlation of regression of 0.77. The calculated regression equation was $y = 0.386X + 0.5345$, where y = the predicted production of chum salmon and x = the recorded production of pink salmon for the same brood year. In terms of the magnitude of error encountered in predicting the production of chums, a comparison of the "predicted" and recorded rates are listed in Table E2. The magnitude of error has averaged 32 percent for the listed years.

The production of pink salmon to the Johnstone Strait-Fraser River area for the 1970, 1971 and 1972 broods has been recorded as 1.26:1, 2.80:1, and 3.81:1 respectively. The less than average pink salmon production of 1970 and 1971 broods would indicate the production of chums from these two brood years would also be less than average. A point estimate of the Study Area chum salmon production for the 1970, 1971 and 1972 broods has been calculated at 1.02:1, 1.62:1, and 2.01:1 respectively.

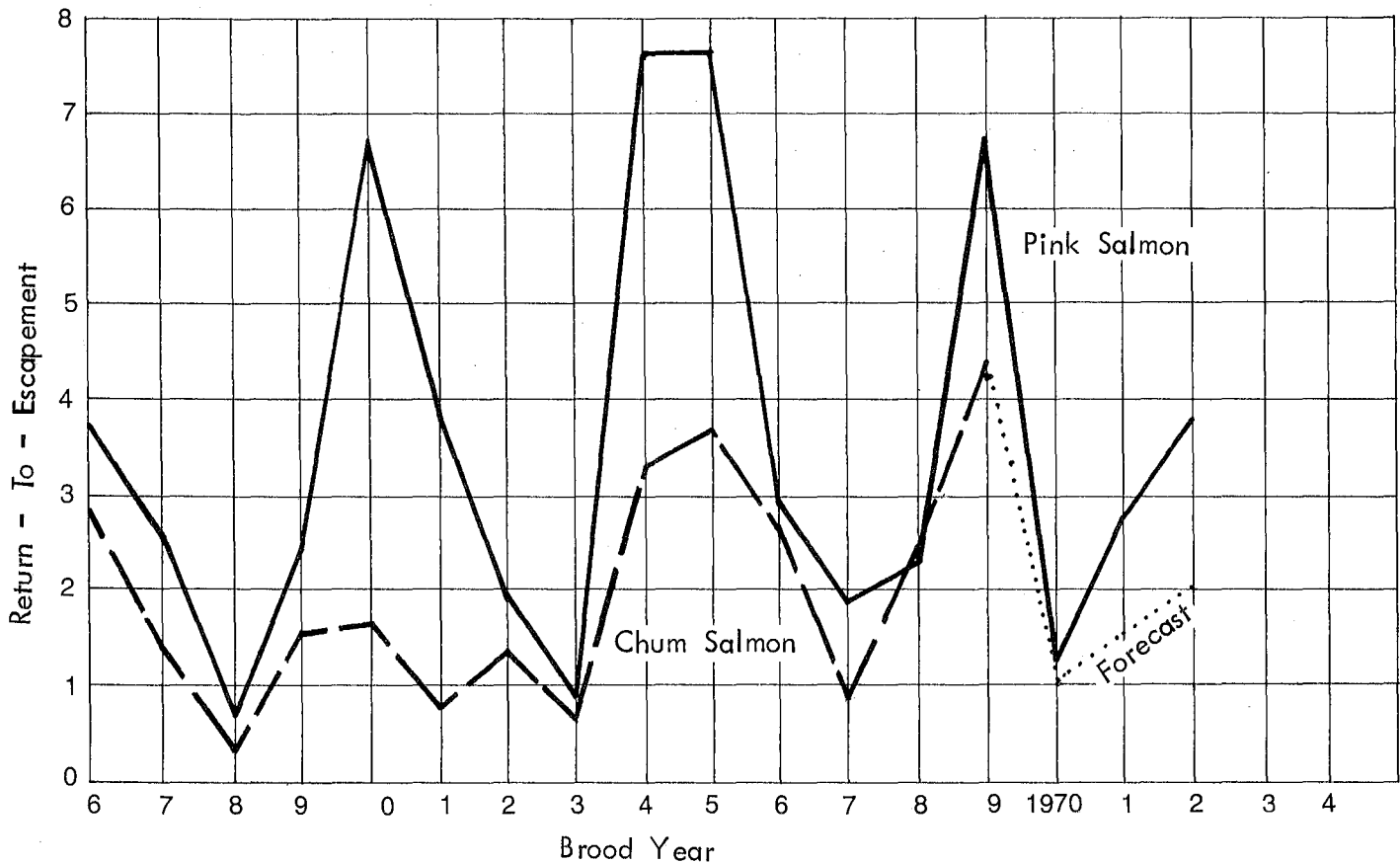


Figure E1. The relationship for pink and chum salmon production of the Johnstone Strait-Fraser River area (1956-1972).

TABLE E1. Pink and chum salmon production of the Johnstone Strait-Fraser River area (1956-1974)¹.

Brood Year	Spawning Escapements of		Total Production of		Escapement-to-Return of	
	Pink Salmon	Chum Salmon	Pink Salmon	Chum Salmon	Pink Salmon	Chum Salmon
1956 ²	554,600	489,300 ³	2,102,100	1,433,000	3.79:1	2.93:1
1957	3,503,900	1,002,800 ³	8,992,400	1,330,900	2.57:1	1.33:1
1958	736,300	1,149,100 ³	565,600	283,200	0.77:1	0.25:1
1959	2,102,700	883,600 ³	4,952,400	1,339,600	2.36:1	1.52:1
1960	221,500	720,400	1,491,400	1,197,900	6.73:1	1.66:1
1961	2,338,000	647,400	9,099,100	521,800	3.89:1	0.81:1
1962	740,700	715,000	1,477,300	960,000	1.99:1	1.34:1
1963	3,734,000	698,100	3,318,500	531,600	0.89:1	0.76:1
1964	623,400	884,800	4,760,900	2,813,100	7.64:1	3.18:1
1965	1,812,500	401,500	13,976,700	1,518,800	7.71:1	3.78:1
1966	1,322,400	983,400	5,254,800	2,762,600	3.97:1	2.81:1
1967	2,210,900	709,000	4,187,900	659,000	1.89:1	0.93:1
1968	1,559,100	1,877,300	3,475,700	4,639,300	2.23:1	2.46:1
1969	1,749,800	1,070,300	11,780,400	4,564,400	6.73:1	4.26:1
1970	1,134,600	1,157,000	1,431,100	1,085,500 ⁴	1.26:1	1.02:1 *
1971	3,213,500	721,100	8,996,600		2.80:1	1.62:1 *
1972	701,400	1,971,700	2,671,800		3.81:1	2.01:1 *

¹ I.P.S.F.C., Annual Report, 1973; Bailey and Anderson, 1974; and Palmer, 1968.

² Chum salmon age analysis not available prior to returns from 1956 brood year.

³ Fraser River mainstem escapement not included.

⁴ Incomplete, five year old contingent returns in 1975.

Forecast *

TABLE E2. Comparison of final and predicted ratio of escapement-return Johnstone Strait-Fraser River Study Area chum salmon (1956-1969).

Brood Year	Escapement-Return		Percent Difference
	Final	Predicted	
1956	2.93:1	2.00:1	+46
1957	1.33:1	1.53:1	-13
1958	0.25:1	0.83:1	-70
1959	1.52:1	1.45:1	+ 5
1960	1.66:1	3.13:1	-47
1961	0.81:1	2.04:1	-60
1962	1.34:1	1.30:1	+ 3
1963	0.76:1	0.88:1	-14
1964	3.18:1	3.49:1	- 9
1965	3.78:1	3.51:1	+ 8
1966	2.81:1	2.07:1	+36
1967	0.93:1	1.26:1	-26
1968	2.47:1	1.40:1	+76
1969	4.26:1	3.13:1	+36
Average			32