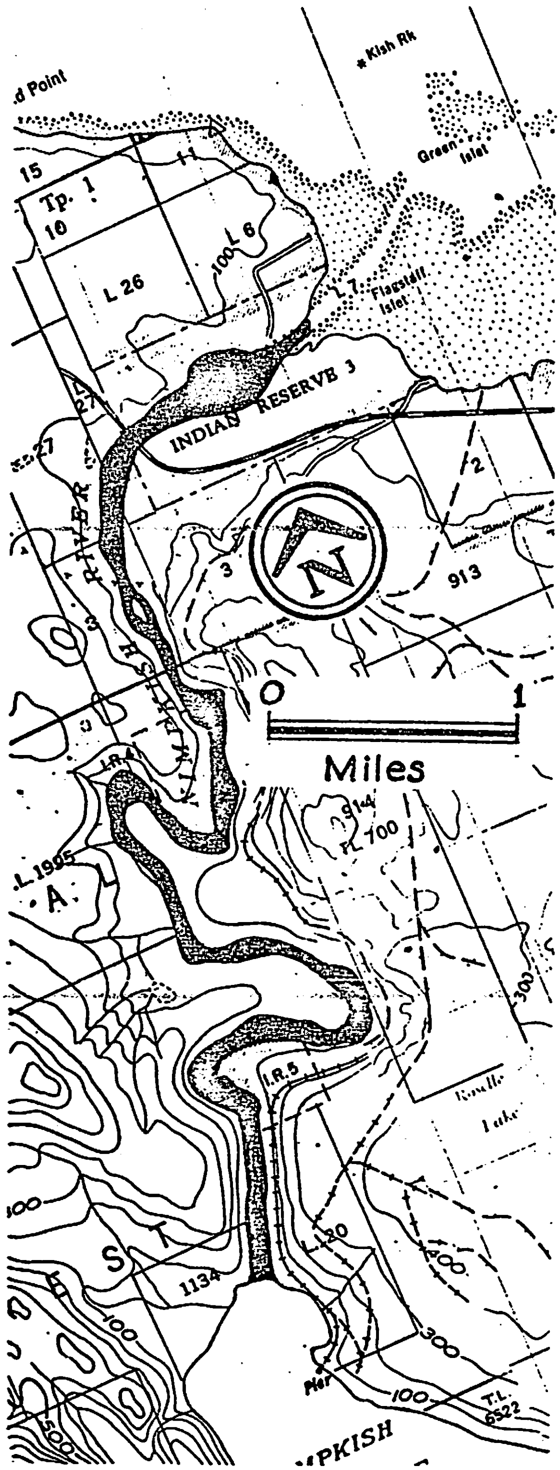

NIMPKISH RIVER 50° 126°NW

LOCATION:

Flows north-west into Broughton Strait through Nimpkish Lake, Rupert District.

CHARACTER:

Beginning at Vernon Lake, the river is joined by Davie River, draining Schoen and Klaklakama Lakes, and Woss River, draining Woss Lake. The large size of the drainage area (768 sq. miles) has spread logging of the watershed over a long enough period of time to keep flow patterns relatively stable. Discharges from 1927 until the station was discontinued in 1938 are presented below. Nimpkish River, from Nimpkish Lake to Broughton Strait, is a large, deep river with a few fairly large areas of gravel.

Nimpkish River Discharges (cfs)

Year	Maximum	Minimum	Mean
1927	45,000	330	4,800
1928	42,500	480	4,730
1929	16,700	590	3,740
1930	34,800	453	3,800
1931	23,600	535	4,700
1932	29,600	705	4,050
1933	25,900	660	4,800
1934	22,400	615	5,000
1935	44,300	330	5,180
1936	21,700	607	4,470
1937	14,900	729	3,880
1938	27,100	720	5,100
Average	29,042	563	4,521

OBSTRUCTIONS:

A natural rock obstruction situated 20 miles above the head of Nimpkish Lake, Karmutsen Falls, was eliminated by blasting a fishway around it in 1953. This rock fishway now permits salmon to migrate into the Schoen and Klaklakama Lakes system.

APPLICATION:

The watershed has been extensively logged over the past years, with operations progressing from the original valley sites to the present day sites at higher elevations. The hydro-electric potential of the system has been examined and a dam proposed for the Lower Nimpkish 0.5 miles upstream from the sea. The dam would be a 150 foot, rock filled structure with appropriate fish passage facilities. Such a dam would obliterate 80% of the chum spawning in the system. Nimpkish Iron Mines, located 6 miles south-east of Nimpkish Lake, was in operation from 1960—1963. The open pit mining included processing at the site and the remaining pile of waste material situated on the bank poses a possible slide threat. Under certain saturated conditions, this waste pile could sluff into the river.

GENERAL:

Of the streams in the southern half of the province, the fishery of Nimpkish stocks is second in value only to that of the Fraser. Spawning occurs throughout the length of the system with the major areas being Woss Lake, which supports the majority of sockeye and springs, and the Nimpkish River (Nimpkish Lake to Broughton Strait), which supports the entire run of chums, some chinooks and the majority of pinks. The figures presented below are from this latter section which was surveyed in July 1970. The average pink escapement for this system is 5,200 (1960-1973).

Nimpkish River—Chum Spawning Area Dimensions

Section	Length (yd)	Width (yd)	Wetted Area (yd²)	Spawning Area (yd²)	Capacity @ 1.1 yd² per fish	Spawning as % of Wetted Area
Main River	1,673	127	2,296,417	109,255	99,323	5%

Mean Chum Escapements

1950-59	1960-69	1970-73
58,000	24,250	17,630

An Inventory of East Coast Vancouver Island Streams Important to Chum Salmon

Technical Report Series PAC/T-74-21

F.J. Fraser
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Canada, Department of Environment
Fisheries and Marine Service
Pacific Region

December 1974

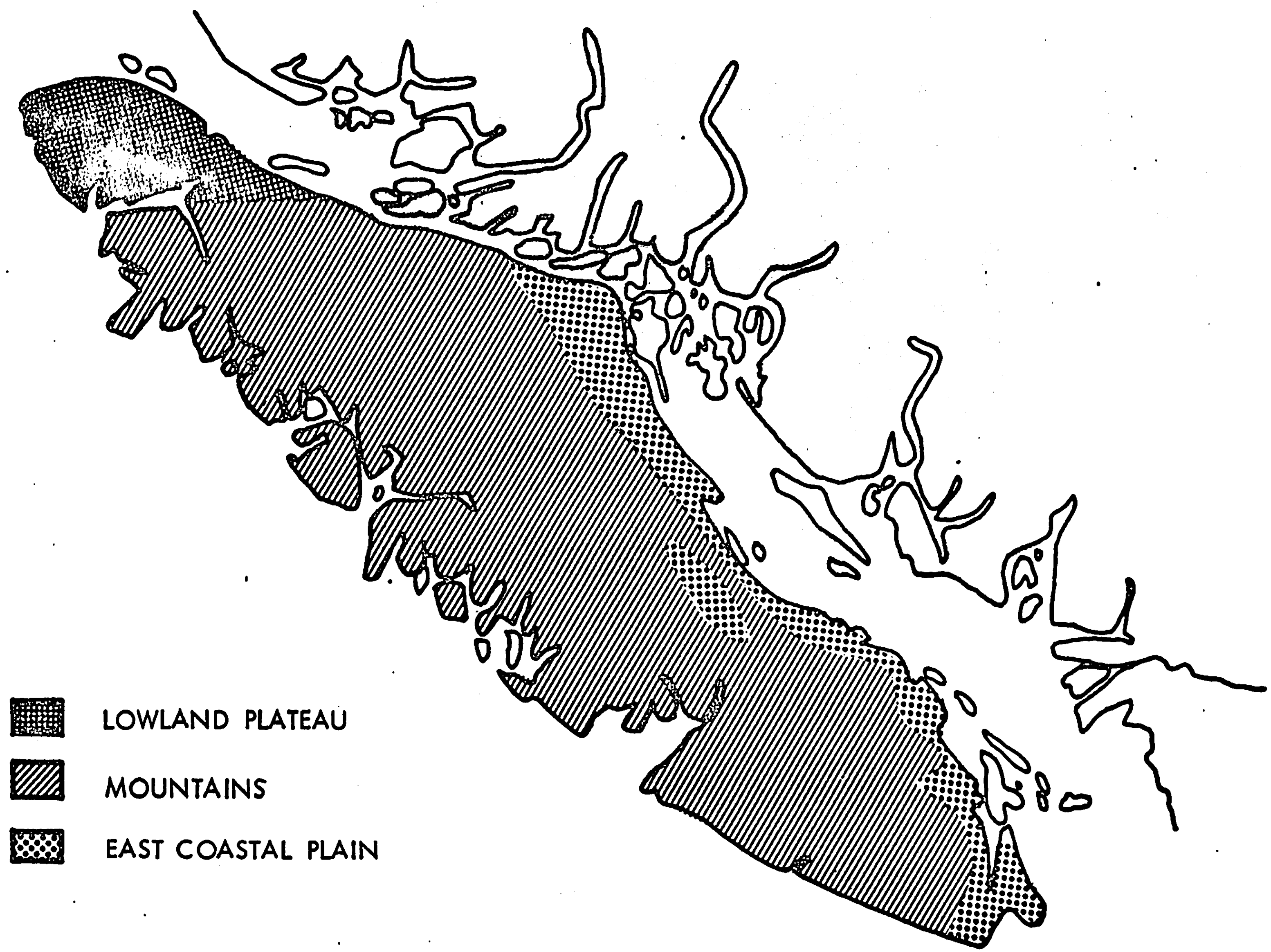

FIGURE I PHYSIOGRAPHIC REGIONS OF VANCOUVER ISLAND.

Geography

Vancouver Island, oriented in a northwest-southeast direction off the southern coast of British Columbia, measures approximately 290 miles by 60 miles and is about 13,000 square miles in area (Figure 1). Vancouver Island consists of a series of northwest trending mountains flanked on its eastern shore by a narrow coastal plain and on its western shore by an island studded, deeply fiorded coast.

The east coastal plain represents an emerged portion of the Pacific Coast Downfold, a great trough extending from the Gulf of California to Alaska. The east coastal plain is generally less than 500 feet above sea level and forms a narrow strip from the southeastern tip of the island to the northern end of the Strait of Georgia. In width, it averages eight miles but varies from less than one mile near Chemainus to 13 miles near Campbell River. The east coastal plain, together with the neighbouring Fraser Valley, is one of the few extensive lowland areas in British Columbia. Its mild marine climate and rich soil make the east coastal plain one of the most favourable parts of British Columbia for human habitation (Anon. 1959). Although representing only a small portion of the area of Vancouver Island, the east coastal plain supports over 90 percent of the population.

From Salmon River northward to Nimpkish River, the Vancouver Island mountain ranges extend to the coast. Streams in this area flow between mountains with up to 5,500 foot elevations. At the north end of the island, the mountain ranges end abruptly along an east-west line through the mouth of Quatsino Sound. Streams northwest of Nimpkish River pass through terrain consisting of areas of flatland separated by low rolling ranges of hills whose highest elevation is about 2,500 feet above sea level. Whereas streams in the east coastal plain and upper lowland areas are generally short, small systems, rivers from Salmon River to Nimpkish River are extensive systems with numerous tributaries.

Climate

Generally, Vancouver Island has a mild marine climate. The west coast of the island has a relatively wet climate with a total annual precipitation over 100 inches and the east coast climate is relatively dry with an annual precipitation of 30-70 inches (Anon. 1959). Mean annual rainfall is 68 inches at Port Hardy, 50-60 inches from Alert Bay south to Parksville, and from 30-40 inches from Parksville south to Victoria. About three quarters of the precipitation occurs from October to March. Summers are characterized by low rainfall and clear sunny weather. Most of the streams are characterized by high winter runoff and low summer flows.

Economics and Industrial Activity

Forestry, agriculture, fishing, mining, and tourism are the main economic activities on Vancouver Island with forestry being the most important (Anon. 1959). Logging operations over the past 100 years have removed much of the mature forest from readily accessible areas and second growth stands are now appearing. Logging operations, pulp and paper, hydro-electric development, gravel removal, domestic and industrial water usage, and an expanding population are threatening many of the salmon producing streams on the east coast of Vancouver Island.

Salmon Resource

The east coast Vancouver Island streams support populations of five species of Pacific salmon. The only significant sockeye population *(Oncorhynchus nerka)* spawns in the Nimpkish River system with an average escapement for the last ten years of 77,000. Table I lists the escapements of chinook *(O. tshawytscha)*, coho *(O. kisutch)*, chum *(O. keta)*, and pink *(O. gorbuscha)* salmon to the three different geographical areas of the east coast of Vancouver Island—upper lowland (Upper Vancouver Island), mountainous (Johnstone Strait), and east coastal plain (Mid and Lower Vancouver Island). Approximately 92 percent of chum escapement, and 75 percent of the coho and chinook escapement, return to streams of the east coastal plain. Pinks are present only in streams from Puntledge River northward and 97 percent of escapement is in the Upper Vancouver Island and Johnstone Strait areas. Salmon escapements to the east coast of Vancouver Island have for the last ten years (1964-1973) averaged 371,000 chum, 502,000 even-year pinks, 69,000 odd-year pinks, 137,000 coho, and 23,000 chinook. East coast Vancouver Island chums account for approximately 25 percent of the chum escapement in southern British Columbia, even-year pinks account for 40 percent, odd year pinks about 3 percent, coho about 30 percent, and chinook about 15 percent.

Listed in order of importance in Table II are approximately 30 percent of the total number of salmon bearing streams on the east coast of Vancouver Island. However, these streams contain 90 percent of the total chum, pink, and chinook escapement and 80 percent of the total coho escapement on the east coast of the island.

Stream Inventory Survey

During the summers of 1969 and 1970, chum producing streams of the east coast of Vancouver Island were surveyed by personnel of the Fisheries Service to provide an inventory of potential chum spawning areas as an aid in resource management; in particular, to optimize utilization of available spawning area. The amount of gravel suitable for chum spawning was estimated and observations made on conditions affecting salmon production within the streambed and the watershed. Possible or actual barriers to upstream migration were examined and evaluated, as were any other factors thought to have a bearing on the stream's productivity. While some observations were made concerning other species of salmon, the emphasis was on chum salmon and particularly upon estimating the chum spawning capacity of each stream. Of the 35 streams surveyed, 27 are located in the east coastal plain, 4 in the Johnstone Strait area, and 4 in the upper lowland area.

METHODS

A Toko optical range finder was used to determine stream dimensions at estimated high-water levels (debris line). The length and width of the stream were determined in convenient adjoining subsections and an accompanying photograph taken. From these measurements, the wetted area was calculated. On the four rivers surveyed in 1969 (Little Qualicum, Chemainus, Cowichan, and Koksilah), an estimate of the total spawning area for all species of salmon was made as a percent of the wetted area of each subsection. The percent of this total spawning area within each subsection, which could be utilized by chum salmon, was then estimated. On the rivers surveyed in 1970 (all the remaining), the spawning area suitable for chums was estimated directly as a percent of the wetted area in each subsection. From the estimate of the total chum spawning area, an estimate of the capacity of the stream was made.

Chum capacity of a stream is calculated using the figure of 1.1 square yards of spawning gravel per fish. This figure is based on spawning behaviour studies by Giles (1967) in the artificial spawning channel #1 at the Big Qualicum River Project and has been corroborated by the observations of natural spawning by various Fisheries Service personnel. This figure allows 2.2 square yards per spawning pair (ignoring unequal sex ratios and multiple spawning by males) and would provide optimum use of the available spawning area.

In this survey, it is assumed that no intertidal spawning takes place even though extensive gravel occurs in many streams in the intertidal zone (Appendix 1).

DISCUSSION

From estimates of spawning capacity from the survey and estimated escapement figures, it is possible to consider the present utilization of available spawning area. Chum escapement as a percentage of estimated chum capacity is presented in Table III. The more northerly streams of Vancouver Island show poor utilization by chum salmon. Since 1960, the streams of Upper Vancouver Island and Johnstone Strait areas, particularly the Quatse, Keogh, Cluxewe, Kokish and Tsultan, Adam and Eve, and Salmon Rivers, have utilized less than five percent of the available surveyed spawning area. However, these streams are large producers of pink salmon; and much of the gravel suitable for chums is also suitable for pink salmon.

Neave (1953) states that "in general, pink and chum salmon occupy somewhat different ecological niches. In fact, one or other usually dominates in a given stream or portion of a river system". It appears that, biologically, these streams are more suitable for pink than chum salmon. However, substantial increases in chum populations should still be possible, at least to the levels of the early 1950's. A few streams support large populations of both species, e.g. Nimpkish and Puntledge.

Only two large streams on Vancouver Island approach or exceed the calculated spawning capacity—Big Qualicum and Little Qualicum. Since 1963, the Big Qualicum has been the site of a major enhancement project of the Fisheries Service and includes flow control, spawning channels, and a hatchery. Since 1950, escapements to east coast Vancouver Island streams have averaged only 32 percent (range 12-59%) of calculated chum capacity. Escapements of pinks in Table III include even and odd year races. However, in recent years, only the even year populations have been important in the Tsulquate, Quatse, Keogh, Cluxewe, Kokish, and

Campbell Rivers. Only the Adam and Salmon Rivers have large even and odd-year escapements. If pink and chum escapements are combined, Vancouver Island streams are still only utilized to 58 percent (range 22-83%) of capacity.[1] In addition to the chum capacity of 1,190,400 in Table III a further 458,800 chums could be accommodated in 504,700 square yards of potentially usable spawning area which exists upstream of the present limits of chum migration. The Cowichan and Salmon Rivers contain 73 percent of this potentially usable spawning area. If this additional capacity is included, chum utilization since 1950 is lowered to 19 percent of capacity and chum plus pink utilization is lowered to 42 percent.

Information on spawning times is available in the International North Pacific Fisheries Commission Bulletin #23 and Department of Environment, Fisheries Service, spawning ground and tagging reports. Although there are discrepancies in some of the information, in most cases the information from different sources coincides. Table III shows the times of peak spawning from spawning ground reports and tagging information. Peak spawning for east coast Vancouver Island pinks occurs from mid September to early October with most occurring in late September. Peak spawning for east coast Vancouver Island chums occurs from mid October to mid December with most spawning in late November and early December. Of the larger chum producers (>10,000 spawners), Nanaimo and Chemainus spawn early (late October-early November), Puntledge and Little Qualicum in the middle (late November), and Nimpkish, Big Qualicum and Cowichan spawn late (early December).

One major chum producing stream, the Campbell River, was not surveyed. At the time the survey was to be undertaken, river flow was too high for any visual measurement of spawning area. Later on, time limitations prevented a return to the river. Escapements for the Campbell River are included at the bottom of Table III.

This survey provides much needed information for salmon management and a data base for more extensive stream information from these and other salmon bearing streams. Surveys of these streams during spawning and incubation, are needed to evaluate such questions as spawning distribution, siltation, flow variation, gravel stability, pink and chum cohabitation, or any factor which could impair or reduce a wetted area's adequacy as spawning area.

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[1]Pink capacity is computed using a figure of 1.0 square yards per spawner.

APPENDIX 1

Intertidal Spawning

The exact extent and efficiency of intertidal spawning has not been determined for the Vancouver Island streams examined. Studies in Alaska, however, have shown that chums will spawn successfully down to the six foot tide level in an area of 12 foot mean high tides (Bailey, 1964). The factors these studies showed to be most important in determining successful intertidal incubation are silting, temperature, and salinity (Helle, 1964; Thorsteinson, 1965). The gradient through the intertidal zone must be sufficient to counteract the silting which occurs at high tides, or there must be sufficient upwelling of groundwater to maintain circulation through the redds. The periodic influx of saltwater over the redds increases the average incubation temperature and significantly increases the rate of development. Dissolved oxygen varies with temperature but levels probably never become critical during the late fall and winter incubation period. Oxygen problems are more likely to be encountered due to lack of circulation through the redds. Intragravel salinity also increases with the oncoming tide. The precise individual effect of these factors or how they interrelate has yet to be determined under controlled condition (Thorsteinson, 1965). The Alaskan field observations show that survival gradually decreases down to zero percent at the six foot tide level (Mattson et al, 1962, 1963, 1964; Bailey, 1964). However, in the upper portions of the intertidal, survival and growth can in some cases be better than that in freshwater (Rockwell, 1956). This is attributed to the moderating effect on temperatures of the saltwater during the extremes of Alaskan winters.

The results of the studies outlined above are useful in predicting the extent and success of intertidal spawning in the rivers under examination. These rivers flow over a coastal plain of varying width before entering the sea. This leads to low gradients through the intertidal with the resultant silt deposition leading to unfavourable spawning and incubation conditions. Any ameliorating effect tidewater might have on the temperature in redds in the intertidal of these streams would not be as significant as that experienced in the more extreme Alaskan climate.

The extensive silting which occurs in the estuaries of the streams examined makes them practically useless as spawning areas with one notable exception. The top 2,500 feet of the Chemainus estuary has a slightly higher gradient and is reported to have upwellings of freshwater through the gravel in some areas (G. Wilson, pers. comm.). These conditions have not been thoroughly examined during spawning and incubation but assuming their existence, this section provides 6,752 square yards of spawning area with a potential capacity of 6,100 chum spawners. These figures are included in the totals for the river. On all other streams, the intertidal spawning capacity was not included but closer examination might reveal groundwater upwelling similar to that reported for the Chemainus (particularly on the Cowichan). The question of intertidal spawning requires further investigation.

TABLE I Salmon Escapements of the East Coast of Vancouver Island (x1000)

Area	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	Mean	
CHUM												
Upper Vancouver Island (Stranby-Hyde Cr.)	13.65	9.43	3.28	1.92	16.00	4.85	4.15	0.53	4.65	2.16	6.06	
Johnstone Strait (Nimpkish-Salmon R.)	16.78	15.80	40.16	17.45	55.83	7.93	19.58	8.25	21.98	26.55	23.03	
Mid Vancouver Island (Amor de Cosmos-Englishman R.)	123.75	40.11	146.53	118.90	337.05	232.60	300.18	165.56	247.05	324.87	203.66	
Lower Vancouver Island (Nanoose-Goldstream R.)	78.30	80.73	220.95	126.45	169.18	142.54	104.19	55.50	226.35	177.86	138.21	
Total	232.48	146.07	410.92	264.72	578.06	387.92	428.10	229.84	500.03	531.44	370.96	
PINK											Even	Odd
Upper Vancouver Island	134.50	30.06	506.50	7.12	466.00	3.04	458.70	6.25	124.70	17.24	338.08	12.74
Johnstone Strait	111.40	104.30	144.58	7.80	185.00	9.60	129.43	61.54	171.93	71.80	148.47	51.01
Mid Vancouver Island	7.45	8.75	17.65	6.90	14.60	1.27	14.55	2.92	20.63	6.05	14.97	5.18
Total	253.35	143.11	668.73	21.82	665.60	13.91	602.68	70.71	317.26	95.09	501.52	68.93
COHO												
Upper Vancouver Island	27.30	22.75	19.55	9.73	20.33	3.20	24.70	7.50	3.11	7.30	14.55	
Johnstone Strait	26.25	50.50	23.00	8.70	18.90	3.00	40.75	18.53	12.15	17.75	21.95	
Mid Vancouver Island	89.90	60.18	80.55	24.36	38.06	15.58	57.39	59.75	21.48	31.28	47.85	
Lower Vancouver Island	119.03	22.10	47.40	46.73	20.89	40.97	91.57	88.64	15.38	38.65	53.14	
Total	262.48	155.53	170.50	89.52	98.18	62.75	214.41	174.42	52.12	94.98	137.49	
CHINOOK												
Johnstone Strait	9.28	4.60	3.60	2.48	8.28	0.80	6.75	1.58	8.33	11.53	5.72	
Mid Vancouver Island	8.18	11.33	6.93	5.65	5.60	7.90	6.32	9.23	9.36	5.98	7.65	
Lower Vancouver Island	8.63	11.13	16.93	4.95	9.18	9.05	9.24	8.81	10.81	9.69	9.84	
Total	26.09	27.06	27.46	13.08	23.06	17.75	22.31	19.62	28.50	27.20	23.21	
SOCKEYE												
Nimpkish	100.00	30.00	120.00	100.00	35.00	100.00	50.00	75.00	60.00	100.00	77.00	

TABLE II Streams on the East Coast of Vancouver Island supporting major populations of Pinks, Chums, Coho and Chinook.

PINK	Mean Escapement 1964-1973
EVEN YEAR	
Keogh	92,000
Bear	87,000
Quatse	80,200
Stranby	62,250
Nahwitti	57,900
Cluxewe	33,200
Adam	27,700
Tsulquate	14,600
ODD YEAR	
Adam	36,200
Salmon	10,500
Keogh	6,100
Tsitika	3,040
Tsolum	2,174
Cluxewe	1,990
Tsulquate	1,536

CHUM	Mean Escapement 1964-1973
Big Qualicum	87,930
Cowichan	61,000
Little Qualicum	54,977
Puntledge	33,750
Nanaimo	33,250
Nimpkish	21,300
Chemainus	13,325
Tsable	8,360
Goldstream	7,380
Holland	5,585
Englishman	5,400

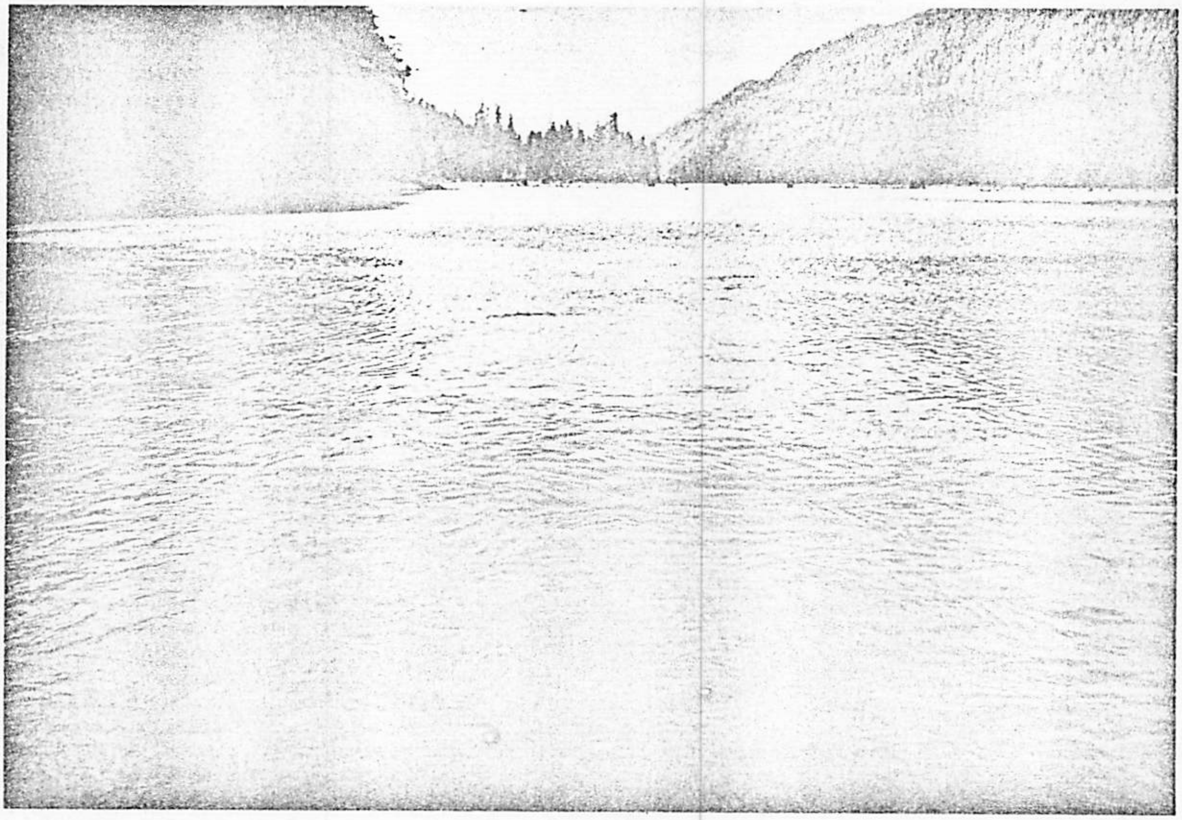
COHO	Mean Escapement 1964-1973
Cowichan	39,900
Nimpkish	15,000
Oyster	7,850
Black	7,786
Tsolum	7,030
Koksilah	7,030
Keogh	4,715
Salmon	4,450
Big Qualicum	3,776
Little Qualicum	3,360
Quatse	3,040
Nanaimo	2,925
French	1,883
Stranby	1,318

CHINOOK	Mean Escapement 1964-1973
Cowichan	8,000
Campbell	5,200
Nimpkish	4,615
Nanaimo	1,500
Big Qualicum	1,101

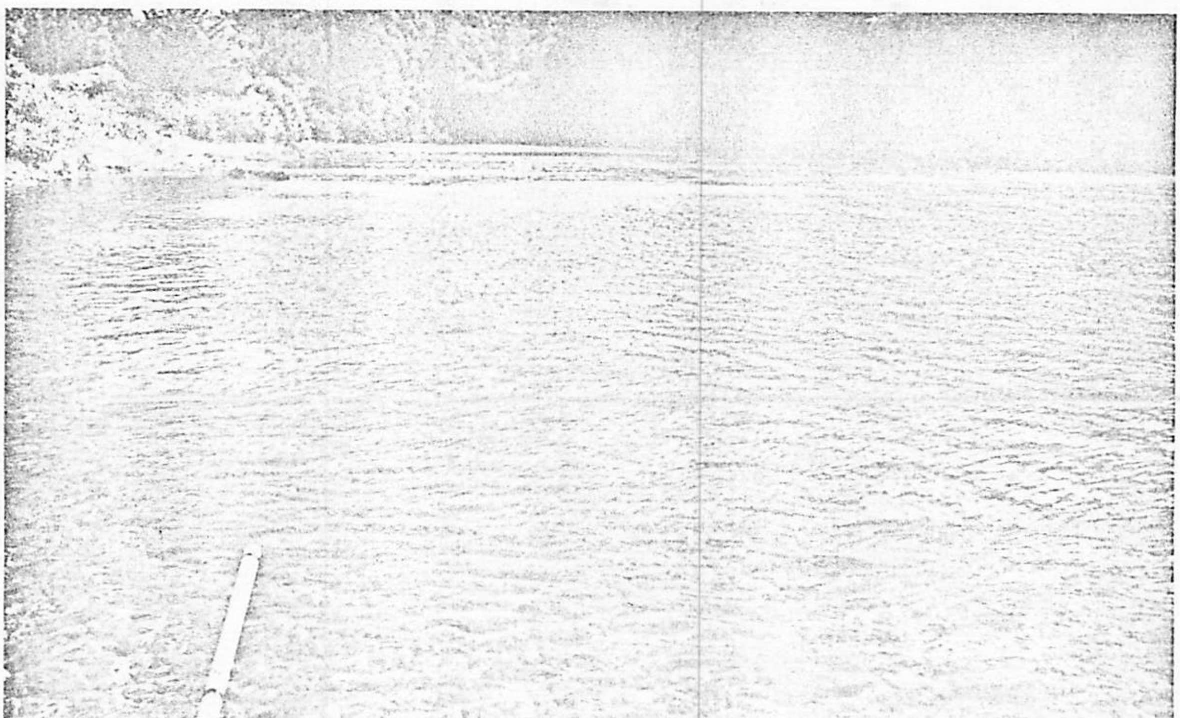
TABLE III Comparison of chum escapement to the East Coast of Vancouver Island with calculated chum capacity. Pink escapements and time of peak chum and pink spawning are also included.

Stream	Calculated Capacity (in thousands)	ESCAPEMENT IN THOUSANDS 1950-1959	1960-1969	1970-1973	ESCAPEMENT AS % OF CHUM CAPACITY 1950-1959	1960-1969	1970-1973	PEAK SPAWNING Chum	Pink
		Upper Vancouver Island							
1. Tsulquate	.2	*1.2 (2.3)	0.6 (3.6)	0.3 (11.7)	600	300	150	L. Oct.	L. Sept.
2. Quatse	49.0	7.8 (25.7)	5.1 (39.8)	1.0 (23.4)	16	10	2	L. Oct.	L. Sept.
3. Keogh	20.4	5.0 (47.8)	2.2 (43.8)	1.0 (46.4)	25	11	5	M. Oct.	L. Sept.
4. Cluxewe	72.8	2.7 (9.1)	0.8 (15.5)	0.2 (10.8)	4	1	0	M. Oct.	M. Sept.
SUB-TOTAL	142.4	16.7 (84.9)	8.7 (102.7)	2.5 (92.3)	12	6	2		
		Johnstone Strait							
5. Nimpkish	99.3	58.0 (5.8)	24.3 (5.3)	17.6 (5.0)	58	24	18	E. Dec. (Dec. 8)**	
6. Kokish & Tsultan	20.1	2.0 (2.5)	0.4 (2.3)	0.2 (0.6)	10	2	1	L. Oct.	L. Sept.
7. Adam & Eve	77.1	3.1 (24.1)	1.1 (35.1)	0.8 (40.0)	4	1	1	L. Oct.	E. Sept.
8. Salmon	208.1	5.8 (8.5)	1.5 (12.5)	0.9 (8.4)	3	1	0	M. Nov.	M. Sept.
SUB TOTAL	404.6	68.9 (40.9)	27.3 (55.2)	19.5 (54.0)	17	7	5		
		Mid-Vancouver Island							
10. Oyster	10.8	5.3 (39.7)	0.5 (1.7)	0.4 (1.3)	49	5	4	M. Nov.	M. Sept.
11. Tsolum	44.9	0.7 54.0)	1.0 (4.7)	0.2 (5.3)	2	2	0	L. Nov.	E. Oct.
12. Puntledge	55.5	33.0 (22.1)	33.4 (2.9)	40.9 (1.1)	59	60	74	M. Nov. (Nov. 25)	L. Sept.
13. Tsable	9.5	7.9	6.5	6.9	83	69	73	M. Nov. (Nov. 16)	
14. Cowie	0.9	4.2	0.8	0.4	457	87	44	L. Nov.	
15. Wilfred	4.6	1.3	0.9	1.6	28	20	35	L. Nov. (Nov. 21)	
16. Waterloo	1.3	1.6	0.6	0.4	119	45	30	L. Nov.	
17. Rosewall	8.7	3.3	1.8	2.1	38	21	24	L. Nov. (Dec. 1)	
18. Cook	7.7	4.2	1.6	4.5	55	21	59	M. Nov.	
19. McNaughton	3.8	4.8	0.9	2.2	127	24	58	L. Nov. (Dec. 12)	
20. Nile	0.5	0.4	0.2	0.1	81	40	20	L. Nov.	
21. Big Qualicum	75.0	41.0	55.5	120.6	55	74	161	E. Dec. (Dec. 7)	
22. Little Qualicum	72.1	43.0	42.5	66.2	60	59	92	L. Nov. (Nov. 28)	
23. French	0.9	0.8	0.6	1.0	86	65	108	E. Nov.	
24. Englishman	42.5	8.1	3.6	7.4	19	9	18	M. Nov. (Nov. 20)	
SUB-TOTAL	338.2	159.6 (115.8)	150.4 (9.3)	254.9 (7.7)	47	44	75		
		Lower Vancouver Island							
25. Nanoose	14.6	2.3	1.0	7.6	16	7	52	E. Nov. (Nov. 6)	
26. Bonell	6.0	7.0	2.2	4.1	117	37	68	M. Nov. (Nov. 8)	
27. Nanaimo	76.6	48.8	20.1	38.4	64	26	50	L. Oct. (Nov. 9)	
28. Bush	4.5	5.4	2.3	4.4	119	51	97	E. Nov. (Oct. 31)	
29. Walker	0.2	1.6	0.3	0.3	737	138	138	L. Nov.	
30. Holland (103rd)	1.8	7.0	4.7	5.9	385	259	325	L. Oct. (Oct. 29)	
31. Stocking Lake	1.3	3.6	1.7	4.2	274	129	320	M. Nov. (Nov. 11)	
32. Chemainus	21.2	37.6	9.2	13.8	177	43	65	L. Oct. (Nov. 4)	
33. Bonsall	0.5	0.8	0.2	0.3	147	37	55	E. Dec.	
34. Cowichan	158.7	64.0	55.5	53.8	40	35	34	E. Dec. (Dec. 18)	
35. Koksilah	13.3	2.5	5.3	3.0	19	40	23	L. Nov.	
36. Goldstream	6.5	13.3	7.0	5.5	205	108	85	M. Nov. (Nov. 22)	
SUB-TOTAL	305.2	193.9	109.5	141.3	64	36	46		
TOTAL	1,190.4	439.1 (241.6)	295.9 (167.2)	418.2 (154.0)	37	25	35		
9 Campbell River		2.4 (2.0)	1.3 (1.3)	3.1 (2.2)				M. Nov.	

*Number preceding brackets is chum escapement, number in brackets is pink escapement.
**Number in brackets from tagging data (A. D. Anderson pers. comm.).



The bottom end of Nimpkish Lake, 13 miles from the mouth. This marks the upstream limit of chum spawning.



A section just above the tidal influence containing about 10 percent chum spawning gravel.