Chum Salmon (*Oncorhynchus keta*) Stock Reconstructions for 1970–1982
Part I: Queen Charlotte Islands, North Coast and Central Coast, British Columbia

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STOCK RECONSTRUCTIONS FOR 1970-1982.

PART I: QUEEN CHARLOTTE ISLANDS, NORTH COAST AND CENTRAL COAST, BRITISH COLUMBIA

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ABSTRACT

Charles, A. T. and M. A. Henderson. 1985. Chum salmon (*Oncorhynchus keta*) stock reconstructions for 1970-1982. Part I: Queen Charlotte Islands, North Coast and Central Coast, British Columbia. Can. Man. Rep. Fish. Aquat. Sci. 1814: 91 p.

Assessments of chum salmon stocks from northern and central British Columbia are presented for the period 1970 to 1982. The run size and catch distribution of each stock is reconstructed by year using data on escapement (number and timing) by stock, catch by area and information on migratory routes for each stock. Allocation of catch into component stocks is made proportionate to the escapement of each stock. For each stock, outputs of the analyses include total catch, catch by fishery, run size, harvest rate and run timing by year. Trends over time in stock status are discussed; the quality of the input data and hence the corresponding level of confidence in these results are felt to be lower, in general, than those of similar sockeye and pink analyses.

Key words: chum salmon, stock assessment, reconstruction

RÉSUMÉ

Charles, A. T. and M. A. Henderson. 1985. Chum salmon (*Oncorhynchus keta*) stock reconstructions for 1970-1982. Part I: Queen Charlotte Islands, North Coast and Central Coast, British Columbia. Can. Man. Rep. Fish. Aquat. Sci. 1814: 91 p.

Le présent rapport porte sur les évaluations des stocks de saumon kéta fréquentant les eaux septentrionales et centrales de la Colombie-Britannique de 1970 à 1982. L'importance de la remonte et la distribution des prises pour chaque stock sont reconstituées selon l'année à l'aide de données sur l'échappée (nombre et époque), les prises par zone et les routes migratoires. La répartition des prises en fonction de chaque stock est proportionnelle à l'échappée pour chaque stock. Les résultats des analyses comprennent les prises totales, les prises dans chaque pêcherie, la taille de la remonte, le taux d'exploitation et l'époque de la remonte chaque année. Les tendances de la situation des stocks en fonction du temps sont examinées. Selon les auteurs, la qualité des données disponibles et donc le niveau correspondant de confiance dans les résultats sont en général inférieurs à ceux d'analyses semblables des saumons coho et rose.

Mot-clés: saumon kéta, évaluation du stock, reconstitution

Foreword

This report is one in a series of stock assessment documents produced by the Salmon Stock Assessment Unit of Fisheries Research Branch, Department of Fisheries and Oceans (Pacific Region). The report has been made possible through the cooperation and assistance of many people, both within and outside the Department of Fisheries and Oceans.

Ron Kadowaki (Fisheries Research Branch) played a major role both in the analysis of North Coast and Queen Charlotte Island chum stocks, and the writing of the corresponding sections herein. Lynda Orman (Queen Charlotte Islands management biologist, Field Services Branch) and members of Field Services Branch on the Queen Charlotte Islands provided much of the information required for analyzing that region's stocks. Barry Huber, Barry Rosenburger, and Tim Panko (Fishery officers for Areas 3, 4, and 5 respectively) generously provided their time and expertise, as well as their data, for the North Coast analysis. Angelo Facchin (British Columbia Fish and Wildlife Branch) kindly made available his Skeena River chum stock analyses, which have been used both in determining escapement timing for those stocks, and in confirming other reconstruction inputs.

Dave Peacock, assisted by Ron Goruk (management biologist, Field Services Branch) contributed extensively to the compilation of data required for the reconstruction of Central Coast chum stocks. In addition, both provided valuable background information required for interpreting the results of the analyses.

Paul Starr (Fisheries Research Branch) prepared the run reconstruction program used for the analysis. Albert Wong (Fisheries Research Branch) wrote summarizing computer programs, gathered and entered data, plotted the figures, and generally made it possible to complete the project.

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Introduction

Chum salmon (Oncorhynchus keta) have been the target of intensive commercial fisheries for approximately 50 years and for a much longer time they have formed an important component of the Indian food fish catch. Chum salmon, however, have never been taken in large numbers in sport fisheries. Since 1951 the annual commercial British Columbia chum salmon catch has ranged from a high of 6.5 million pieces in 1954 to less than a million pieces in 1965. The average annual catch over this period was 2.5 million pieces. Over the period of our study, 1970 to 1982, the average annual British Columbia chum catch was 2.7 million pieces or approximately 14% of the entire British Columbia salmon catch. Almost 70% of the total British Columbia chum catch is taken in the Queen Charlotte Islands, North Coast and Central Coast regions (i.e. statistical areas 1 through 10); this is dominated by the catch from statistical areas 7,8, and 2E.

The objective of this report is to generate the information required to assess the status of chum salmon stocks in the northern and central portions of British Columbia (Fig. 1). The same information for south coast chum stocks will be presented in Part II. For each commercially exploited chum stock (or relevant stock grouping), we estimate the catch, escapement, total run size, harvest rate and percent catch by fishery for each year between 1970 and 1982. In addition, we provide information on the run timing of chum stocks entering the fisheries. The information contained herein is essential both for evaluating the effects of past management actions and for providing a reliable basis on which to develop new management initiatives.

Spawning populations of chum salmon have been identified in almost 1,000 streams along the coast of British Columbia and there is not the concentration in a smaller number of streams evident in the case of pink and sockeye salmon. The spawning of chum salmon in British Columbia takes place over a considerably longer period than that of pink and sockeye salmon, and generally the arrival of chum on the spawning grounds is later, on average, than that of the other two net species. Stocks from northern British Columbia arrive on their spawning grounds as early as July while more southern stocks spawn between September and early January. Chum salmon ranging in age from two to seven years are taken in commercial fisheries (Pritchard 1943), however 90 to 99% of the spawners are in their third or fourth year. The mixture of brood years represented in spawning runs makes assessment of the status of chum stocks more difficult than for pink salmon.

The report is divided into several sections. First is a description of the method of analysis, data sources and an annotated example of the results of the analysis for one stock. This is followed by the stock-by-stock descriptions of the reconstruction results. The stocks described in this report are grouped into three broad, management-defined geographical areas (Fig. 1): Queen Charlotte Islands (statistical areas 1, 2W and 2E), North Coast (statistical areas 3, 4 and 5) and Central Coast (statistical areas 6 through 10). In the analysis itself, the Queen Charlotte Islands and the North Coast have been considered together, in order to ensure that this reconstruction region was more or less self-contained (although some corrections were necessary as discussed below).

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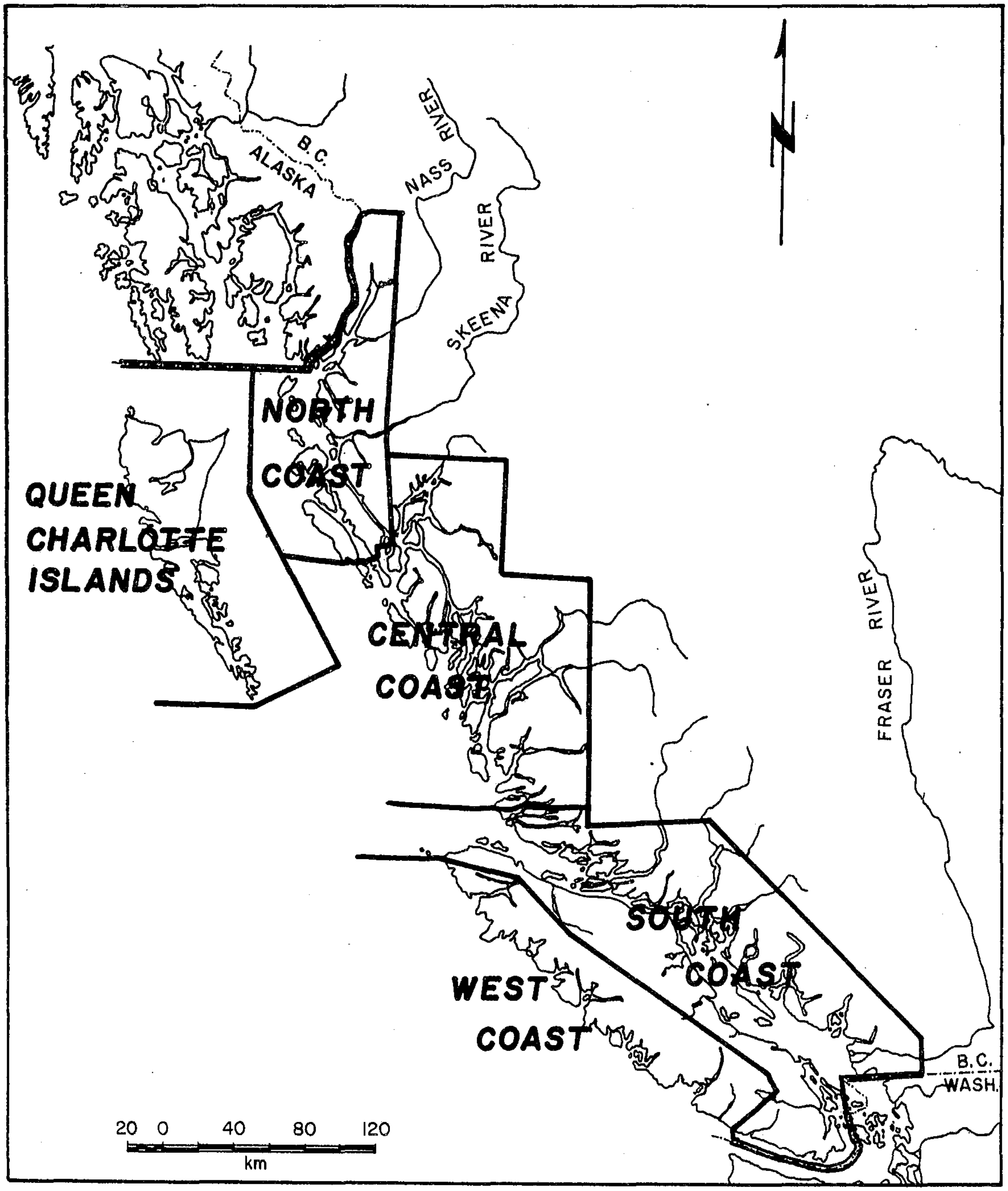

Fig. 1. The five regions of British Columbia used in reconstruction analyses.

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Methodology

The Run Reconstruction Approach

The results described in this report were obtained using a method of analysis known as run reconstruction. The method addresses a basic problem in salmon stock assessment: if escapement is measured for each fish stock, while catch is determined by fishery, how can the catch in each fishery be allocated between fish stocks to determine total run size? This question must be resolved before a full analysis of harvest rates, exploitation rates, stock and recruitment, and trends in stock sizes can be undertaken.

To allocate catch between fish stocks, one can either follow a static procedure based on historical proportions of the catch in each fishery arising from each stock, or adopt a systematic dynamic method for analysing the movements of each fish stock through and between the fisheries. The former approach is widely known as the 'PRUNES' method, after the allocation table of the same name ("Pacific Region US-Canada Negotiating System"). It is a static methodology, incorporating potentially out-of-date information on fishing patterns, migration rates and timing, and does not take into account year-to-year variations in relative stock strength. The second approach, which is used in run reconstruction, involves estimates of escapement timing (proportions of the fish stock escaping past the last fishery in each time period), migration routings (the possible ways in which each fish stock passes through the various fisheries), and 'diversion rates' (proportions of each stock following each migration routing). Together, this information makes it possible to track each fish stock through the fisheries on a week-to-week basis. Of course, data on timing, routing and diversion rates are by no means complete and precise, but the experience of fishery officers and biologists, together with results from tagging studies, produces the best current estimates, which can be updated each year as new information becomes available.

The run reconstruction approach works backwards in time. Annual escapement data by stock, together with escapement timing information, produce week-to-week escapement values. Using the assumed diversion rates, each stock is subdivided into 'sub-stocks', each sub-stock corresponding to a stock-migration route combination. (For example, chum runs to Area 2E are assumed to follow one of 3 migration routes into their escapement areas; there are thus 3 sub-stocks corresponding to each major stock of Area 2E. Differences in escapement timing can also necessitate differentiating between sub-stocks of a single major stock). Given the week-to-week escapement for each sub-stock, it is essentially a book-keeping exercise to track each sub-stock backwards in time. For each time period, the catch in each fishery is allocated proportionately between all sub-stocks present on the basis of how many fish of each sub-stock are known to have escaped the fishery at the end of the given time period. As the process works back in time, the run of each stock builds up, as more and more catch is added in. Eventually, each sub-stock is tracked back to the time at which it first entered the outer-most fishery along its migration route. At this point, the total entering run has been determined for that sub-stock.

Once catches have been allocated and runs determined, overall harvest rates on each major stock can be calculated, together with the week-by-week timing curve for the entering run of each stock. All this information, when assembled, produces a picture of the stock-by-stock and fishery-by-fishery exploitation pattern for the year under consideration.

While the run reconstruction methodology is straightforward in principle, the key to a successful analysis lies in the choice of appropriate fish stock aggregations, fishery aggregations, and migration route possibilities, as well as the choice of a suitable time step for the analysis. These choices are discussed in Starr & Hilborn (1985), where details of the run reconstruction process are also presented.

<u>Formulating the Run Reconstruction Analysis</u>

Within each reconstruction region, the relevant stock and fishery aggregations must be determined. Several factors influence the choice of relevant fish stocks:

(1) Does the proposed stock differ in escapement timing and/or migration routing from other stocks?
(2) If not, are there logical reasons for separating the stock from others (such as a different history of exploitation or a special significance)?
(3) In any case, does the proposed set of stocks make sense, with respect to the biological and management concerns?

The stocks used in this report are more aggregated than one might feel appropriate from a biological point of view. However they represent a balance between biological "correctness", data availability, computer limitations, and manageability of the fish stocks. The rationale for the choice of stocks is presented, for each geographical region, in the corresponding section below.

The choice of fisheries is intertwined with the selection of a suitable time step for the analysis. If fish move rapidly from the outermost fishery to escapement, then either fisheries must be aggregated into larger units, or a finer time step must be used. The primary requirement is that a given fish must be resident in only one fishery within a given time step. For example, if a time step of one week is used for the North Coast/Queen Charlotte Islands region, then the fisheries of Areas 3, 4 and 5 must be aggregated, since fish can usually move between these areas in less than one week. Alternatively, a shorter time step could be adopted, but this has its limitations since data on catch, escapement timing and travel times are known only imprecisely. For this report a compromise time step of 1/2 week was used in the analysis (but results are presented on a weekly basis for ease of understanding). Using the 1/2 week time period, appropriate fishery aggregations were selected and reasonable estimates of travel times between these fisheries were made.

Once the appropriate fishery combinations have been selected, annual catch data can be examined. The basic sources for this data are the Department of Fisheries and Oceans (DFO) annual B.C. Catch Statistics and the DFO Pacific Region Historical Salmon Commercial Catch Data System. In cases where less aggregated catch data is required, the catch of a statistical area is divided among fisheries in proportion to hail figures obtained by fishery officers during the fishery. Data available on a weekly basis has been divided into 1/2 week time periods according to the following general rules:

(1) troll catch in a given week is divided evenly between the 2 halves of the week.

(2) net catch is allocated entirely to the first half of the week, unless information on the fishery in question shows that openings occurred entirely or partially in the second half of the week, in which case a proportional allocation is used.

In general, extensive uncertainties in other components of the analysis (timing, routing and diversion rates) are such that great precision in allocating catch between time periods is not warranted.

Escapement data for each stock aggregation were collated from a variety of sources, including stream catalogues, Field Services Branch and Salmon Commission escapement files, and various reports. For purposes of the analysis, native food fishery catch, where significant, has been added into escapement data. (This catch information, available by statistical area, is allocated to major stocks within a statistical area in proportion to the escapement.) However, final results presented below include native food catch under 'Catch' rather than 'Escapement'. Escapement timing information was obtained with widely varying degrees of confidence: sources included test fishery data, 'catch per unit effort' data, stream catalogues, and to a large extent, management biologist and fishery officer estimates. Typically the latter information involved estimates of the start, peak and end of the escapement past the last commercial fishery; a binomial timing distribution was then fit to these 3 dates, and adjustments made for any unusual features of the timing. Where possible the timing data were obtained for each stock within a stock aggregation, and the overall timing calculated as an average, weighted by the mean relative run size for each stock.

Formulation of migration routing possibilities for each stock is the most difficult aspect of the run reconstruction procedure. While catch and escapement counts and timing estimates are based on physical measurements or observations, migration routes and the proportion of the stock following each route must be inferred from the appearance of fish in the fisheries (unless extensive tagging studies have been carried out in the area). For many northern chum stocks, a large number of possible routes exist from the outermost fisheries to escapement, and the 'diversion rate' proportions are unclear. However past tagging studies, in particular the Central Coast Salmon Tagging Report (Aquatic Resources Ltd., 1980) and partial results for chum salmon obtained in the North Coast Salmon Tagging Project, have been used to provide some guidance in selecting major routing possibilities and reasonable diversion rates for these regions.

Run Reconstruction Results: An Example

As described above, the run reconstruction process occurs on a year-by-year basis. Each run reconstruction produces an analysis of all stocks within the major geographical region under consideration. The 6 outputs produced are as follows:

(1) Summary Table of total annual run, catch, escapement and harvest rate by stock and sub-stock,
(2) The distribution of catch of each stock between fisheries,
(3) The proportional allocation of the catch in each fishery to the stocks vulnerable to that fishery,
(4) The entering run timing for each sub-stock (ie. the proportion of the sub-stock entering the outermost fishery in each time period),
(5) The harvest rate in each fishery during each time period,
(6) The weekly catch contributions from each stock in each fishery (eg. the catch of each stock, and sub-stock, in a particular fishery for a given week).

Since the emphasis in this report is on the status of the fish stocks, rather than on the state of the fisheries, the results presented here are organized by fish stock. Outputs (1) and (2) above have been amalgamated into one table, while the entering run timing results for each stock have been averaged over the time frame of this analysis (1970-1982) to produce a composite timing curve, together with an indication of the variability in the timing. Whereas the run reconstruction process produces a single year's results for all stocks, these results have been rearranged in this report to display 1970-1982 data for each stock separately. In this section, we present annotated samples of the results described in this report.

The summary data table shown below depicts time series of total annual run, catch, escapement and harvest rate, along with the year-by-year proportions of the catch of the stock which are harvested in each fishery. Note that only fisheries currently or potentially impacting on the stock in question are represented in the table. In the first figure below, the annual run, catch and escapement results are plottedfor the period 1970-1982. For each stock, the scale is chosen appropriate to the overall size of that stock. (Hence one must be careful to note differences in the scales when comparing between stocks.)

The second figure deals with entering run timing. The timing curve represents an unweighted average of the 13 annual timing curves produced for the given stock (where in a particular year entering timing curves for individual sub-stocks have been averaged, weighted by their respective run sizes for that year). Also shown is the median for the averaged curve (ie. the time at which 50% of the total run has entered the system) and a range for this median (the minimum and maximum median times over the period 1970-1982). Taken together, this information provides a reasonable indication of average timing, and variability in that timing, for each stock.

Note that there are 4 possible configurations for the median of the average timing curve and the spread in timing. Since timing is only considered in discrete weeks in these curves, the <u>average</u> median timing may lie in the centre of the "spread", at one end or the other, or there may be no timing variability at all (under the assumptions of the analysis).

STOCK: AREA 3 PORTLAND/NASS

YEAR	TOTAL RUN	TOTAL CATCH	TOTAL ESCAPE	HARVEST RATE	%CATCH NATIVE	%CATCH A1 TRL	%CATCH A1 NET	%CATCH AR 3XY	%CATCH AR 3Z	%CATCH AREA 4	%CATCH NOYES	%CATCH C.FOX
1970	90608	63931	26677	70.56	1.03	0.00	0.00	9.90	70.70	6.73	0.30	11.34
1971	38309	19287	19022	50.35	0.43	0.00	0.00	15.57	53.14	10.75	0.00	20.11
1972	168516	115388	53128	68.47	0.31	0.00	0.00	18.73	54.86	11.10	0.22	14.78
1973	129391	93364	36027	72.16	0.45	0.00	0.00	7.27	67.23	12.55	0.49	12.00
1974	79597	39390	40207	49.49	0.57	0.00	0.00	18.31	55.26	16.52	0.54	8.81
1975	24062	7062	17000	29.35	3.41	0.00	0.00	22.43	26.91	25.71	2.63	18.92
1976	36797	12651	24146	34.38	2.62	0.00	0.00	22.53	23.58	8.88	4.05	38.33
1977	96977	74202	22775	76.51	0.59	0.00	0.00	17.46	62.91	10.88	0.86	7.29
1978	107111	66640	40471	62.22	0.60	0.00	0.00	26.37	35.48	18.01	1.47	18.08
1979	22586	13302	9284	58.89	2.60	0.00	0.00	24.46	23.83	26.62	7.24	15.25
1980	128789	107095	21694	83.16	0.38	0.00	0.00	21.91	48.22	16.23	2.80	10.46
1981	28122	21394	6728	76.08	1.06	0.00	0.00	30.09	22.64	32.52	2.26	11.43
1982	63622	45345	18277	71.27	1.28	0.00	0.00	20.81	16.92	41.55	4.15	15.29

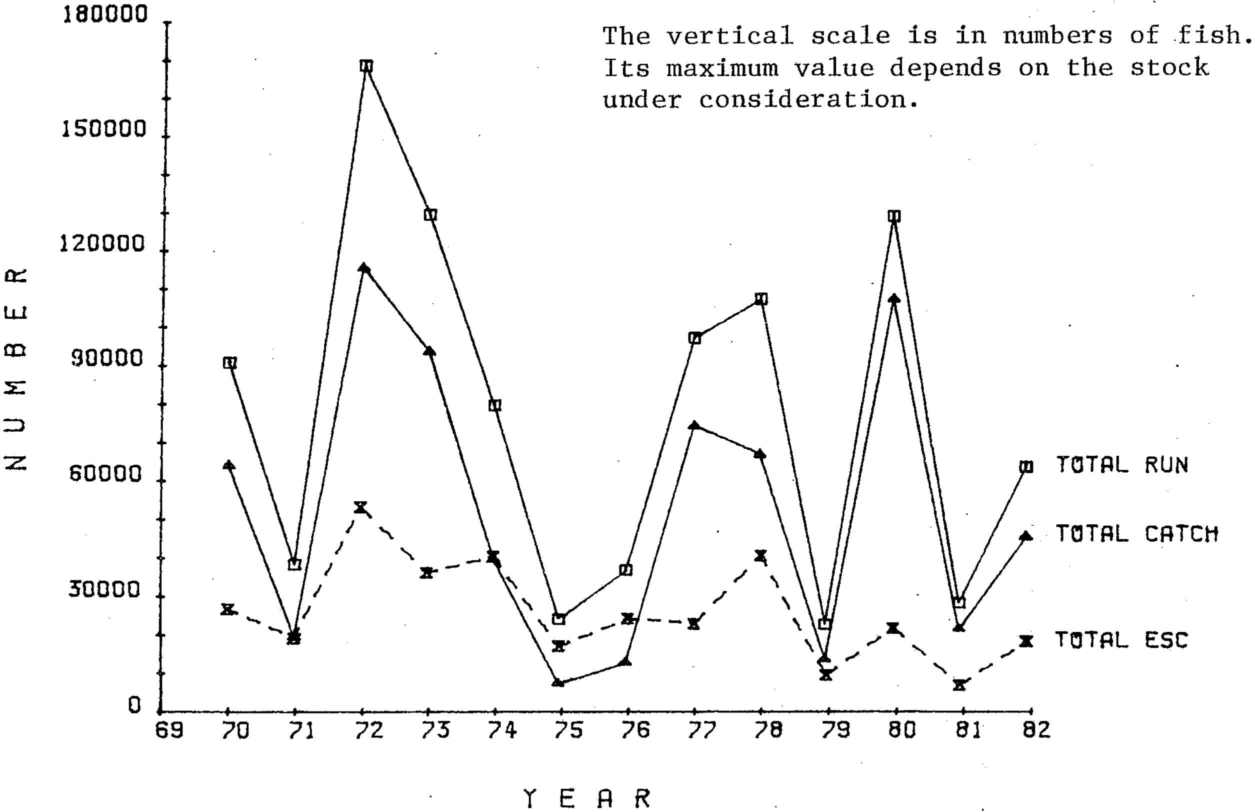
Harvest Rate

$$= \frac{\text{Total Catch}}{\text{Total Run}} \times 100\%$$

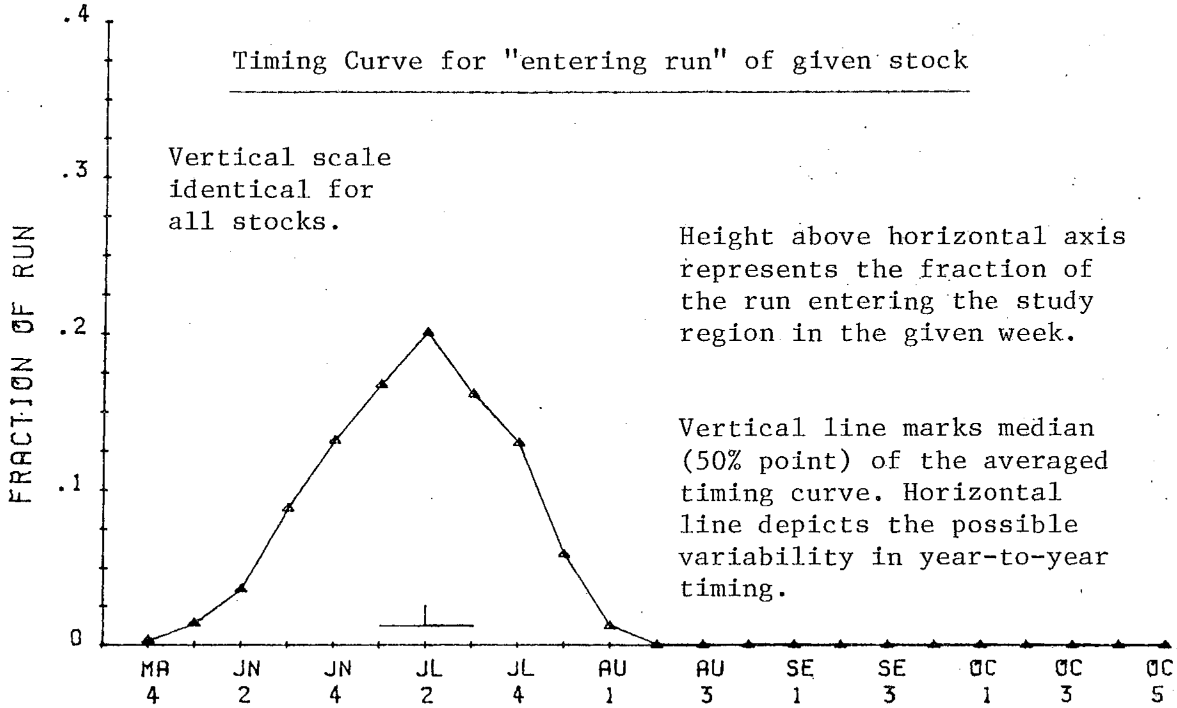
Percentage of total catch obtained in native food fishery (where relevant).

Fisheries of relevance to the Area 3 Portland/Nass chum stock, including the native food fishery, Canadian commercial fisheries in Area 1 (Troll and Net), Areas 3X and 3Y, Area 3Z and Area 4, as well as U.S. commercial fisheries at Noyes Island and Cape Fox. Note that while this stock is not caught in the Area 1 fisheries, it is assumed to pass through these fisheries and hence they are included here.

Year-by-year Run, Catch and Escapement



Timing Curve for "entering run" of given stock



Statistical weeks, from 4th week of May to 5th week of October

Data Sources

The following describes the primary sources for each input into the run reconstruction process, by geographical area.

Queen Charlotte Islands and North Coast

Catch:	(1)	DFO Pacific Region Historical Salmon Commercial Catch Data System (Wong, 1982).
	(2)	Alaska Department of Fish and Game catch statistics (Noyes Island and Cape Fox catches)
	(3)	Annual 'Area Histories' (Native food fishery catches, Number of days open/week).
	(4)	1982 North Coast Tagging Project (Gazey and Birdsall, 1983) and Field Services Branch (FSB) Management Biology estimates (for apportioning catch of interception fisheries into 'local' and 'non-local' components).
	(5)	Area 2E hail figures (to allocate catch between sub-areas).
Escapement:	(1)	Fishery officer estimates
	(2)	Stream catalogues
	(3)	FSB revised data
	(4)	B.C. Fish and Wildlife Department Skeena River analyses
Timing:	(1)	Test fishery data
	(2)	Stream catalogues
	(3)	FSB biologist and fishery officer estimates
	(4)	B.C. Fish and Wildlife Department Skeena analyses
Migration Pattern:	(1)	North Coast Tagging Project
	(2)	FSB biologist and fishery officer estimates

Central Coast

Catch:	(1)	DFO Pacific Region Historical Salmon Commercial Catch Data System (Wong 1982)
	(2)	Annual "Area Histories" and Area Summaries (hail counts, number of days open/week)
	(3)	Central Coast Tagging Project (Aquatic Resources Ltd., 1980) (for apportioning catch of interception fisheries into individual stock components)
Escapement:	(1)	Stream catalogues
	(2)	FSB revised estimate
	(3)	Area 8 Workshop (1983)
	(4)	Fishery officer estimates
Timing:	(1)	Commercial fishery C.P.U.E.
	(2)	FSB biologist and fishery officer estimates
	(3)	Stream catalogues
Migration Pattern:	(1)	Central Coast Tagging Study (1980)
	(2)	FSB biologist and fishery officer estimates

Queen Charlotte Islands

The Queen Charlotte Islands, made up of Graham Island on the north and Moresby Island to the south, are located between 80 and 150 kilometres off the north coast of British Columbia, separated from the mainland by Hecate Strait (Fig. 2). Prince of Wales Island in Alaska is due north of Graham Island across Dixon Entrance.

Chum salmon are found in significant numbers on the north, west and east coasts of the Queen Charlotte Islands, representing statistical areas 1, 2W and 2E respectively. While Area 1 and 2W each form natural stock aggregation areas for the purpose of this analysis, Area 2E has been divided into 2 stock groups in order to highlight the Skidegate Inlet system as distinct from southern Area 2E stocks (Table 1).

Estimates of the optimal escapement levels for Queen Charlotte Islands chum salmon are: 85,000 in Area 1; 200,000 in Area 2W; and 400,000 in Area 2E, of which 100,000 is the minimum level considered appropriate for Skidegate Inlet chum. Over the time period 1970-1982, these escapement targets were never reached, although the 1982 Area 1 escapement approached its target and Area 2E Skidegate escapements have reached the minimum goal at times in recent years. By and large, local fisheries have been closely regulated, with wide variations in catch depending on stock abundance, and effort being restricted in some years to passing stocks or identifiable surpluses. The fisheries, primary gear types, and catch timing in the Area 1, Area 2W, Area 2E South and Area 2E Skidegate and Noyes Island fisheries are shown in Table 2. The reported catch statisitics for area 2E have been divided between the South and Skidegate fisheries in proportion to the relevant hail counts, on a half-weekly basis in each year. These proportions are shown in Table 3.

The timing of Queen Charlotte Islands chum stocks in considerably later than those of the North Coast region, with escapement into the spawning streams occurring from early September to late October (Table 1). The peak escapement timing varies between the stock aggregates, being earliest for Area 2W (3rd week of September) and latest for Area 2E South (1st week of October). Due to a lack of more complete information, it has been assumed that escapement timing has remained the same throughout the time period of the analysis.

There is considerable uncertainty concerning the migration routes by which Queen Charlotte Islands chum stocks pass through the fisheries on their way to the spawning grounds. In this study, fishery officer and management biologist estimates have been used in describing these routes and the proportion of the stocks following each route (Table 4).

It has been assumed that Area 1 chum stocks split between (i) those that pass Noyes Island and Dixon Entrance on their migration to the Area 1 net fishery and subsequent escapement, and (ii) those that avoid all but the terminal fishery in Area 1. Chum stocks of Area 2W are assumed to approach the terminal fishery via either Noyes Island or the Langara Area 1 fishery. The two stocks of Area 2E can reach their terminal areas either (i) directly, (ii) via Noyes Island and Area 1, or (iii) via Area 2W and a southern approach. The proportion following the latter route is assumed to be greater for the Area 2E South than for the Skidegate stock grouping.

Interceptions of Canadian chum stocks in Alaska and interceptions of Alaskan chum in Canadian fisheries have received less study than similar interceptions for pink and sockeye salmon (North Coast Tagging Project, Gazey and Birdsall, 1983). This is nevertheless an important component to take into account in attempting to determine the catch in a fishery that is due to a particular stock. Annual variations in relative run strengths, migration routes and timing and the lack of reliable stock identification techniques has made progress in this area difficult. In this analysis, an attempt has been made to isolate the 'study area' (North Coast plus Queen Charlotte Islands) catch component in each fishery, using 'proportion local' factors (Table 5) drawn primarily from management biologist estimates.

The proportion of the catch in a fishery that is of 'local' study area origin depends on the location of that fishery and the time period under consideration. Due to a lack of more detailed information, the 'proportion local' factors for fisheries of relevance to the Queen Charlotte Islands are taken to be invariant from year to year. Since this assumption of invariance may not necessarily be accurate, and since the run timing and diversion rate inputs to the run reconstruction analysis cannot fully reflect year-to-year variablility, the model may not always fully account for all catch in each fishery. Such 'unexplained' catches for each year of the analysis are shown in Table 6. Note that for Queen Charlotte Islands fisheries, and for Noyes Island, all catches are explained by the analysis so that uncertainties in the input parameters do not appear to pose serious problems.

The combined Queen Charlotte Islands annual run, catch and escapement are shown in Fig. 3, for the period 1970-82. These results, obtained by aggregating the Area 1, Area 2W and Area 2E stocks described in more detail below, show the following general features:

(i) a dramatic decline in the catch of Queen Charlotte Islands chum stocks from 1970-1973 levels to a fairly stable but much reduced harvest over the period 1974-1982, and

(ii) a relatively steady escapement pattern, with a slight decrease up to 1975 followed by generally increasing levels to 1982.

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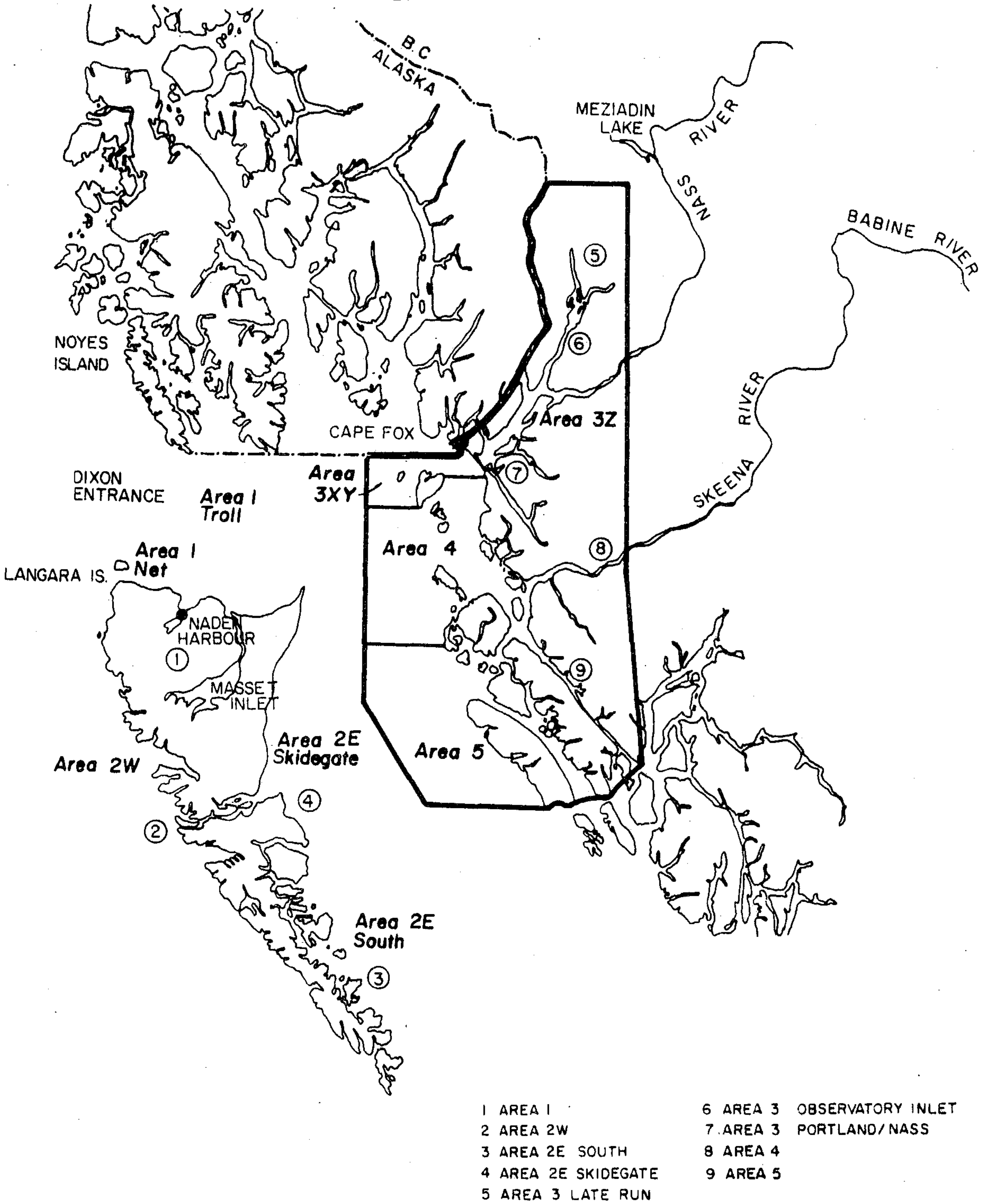

Fig. 2. The major chum salmon stocks (circled numerals) and chum salmon fisheries (boldface type) in the Queen Charlotte Islands / North Coast region.

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Table 1. Stock groups and terminal area run timing for Queen Charlotte Island chum stocks.

	Escapement Timing		
Stock	Start	Peak	End
Area 1	early September	4th week September	late October
Area 2W	late August	3rd week September	mid October
Area 2E (South)	early-mid September	1st week October	late October
Area 2E (Skidegate)	early September	4th week September	mid-late October

Table 2. Gear type and pink catch timing in major commercial fisheries harvesting Queen Charlotte Islands chum stocks (fishery abbreviations in parentheses).

Fishery	Gear Type	Catch Timing		
		Start	Peak	End
Noyes Island, Alaska	seine	early July	mid July–mid August	early September
Area 1 Troll (A1-T)	troll	mid August	mid August	early October
Area 1 Net (A1-N)	seine	mid August	highly variable	mid October
Area 2W (A2W)	seine	mid August	mid-late September	early October
Area 2E (A2E-S, A2E-SK) (South and Skidegate)	seine	early September	late September	mid October

Table 3. Fraction of total annual Area 2E catch harvested in Skidegate area fishery, by half-week.
(No catches occur in weeks not shown in this table.)

	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982
AU 1A	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0
AU 2A	0	0	1	0	0	0	0	.46	0	0	0	0	0
	0	0	1	0	0	0	0	.46	0	0	0	0	0
AU 3A	0	0	.91	0	.18	0	0	.21	0	0	0	0	0
	0	0	.91	0	.18	0	0	.21	0	0	0	0	0
AU 4A	0	0	.37	0	.96	.88	0	0	.84	0	0	0	0
	0	0	.37	0	.96	.88	0	0	.84	0	0	0	0
SE 1A	0	0	.73	0	0	0	0	0	.82	0	0	1	0
	0	0	.73	0	0	0	0	0	.82	0	0	1	0
SE 2A	0	0	0	0	0	0	0	0	1	0	1	1	0
	0	0	0	0	0	0	0	0	1	0	1	1	0
SE 3A	0	0	.46	0	.36	0	0	0	1	0	0	0	1
	0	0	.46	0	.36	0	0	0	1	0	0	0	1
SE 4A	0	0	.16	.07	.35	0	0	.13	.67	0	1	0	0
	0	0	.16	.07	.35	0	0	.13	.67	0	1	0	0
OC 1A	0	0	.1	.05	0	0	.06	.16	1	0	0	1	0
	0	0	.1	.05	0	0	.06	.16	1	0	0	1	0
OC 2A	0	0	0	.05	0	0	0	0	0	0	.16	0	0
	0	0	0	.05	0	0	0	0	0	0	.16	0	0
OC 3A	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0
OC 4A	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0		0	0	0	0	0	0	0	0	0	0

Table 4. Migration routes and diversion rates for major Queen Charlotte Islands chum stock aggregations. (Migration time between fisheries is 1/2 week except 1 week or 1 1/2 weeks where indicated by * or ** respectively)

Stock Name	Routing by Fishery	Proportion of Stock Utilizing each Route
Area 1	Noyes --> A1-T --> A1-N --> esc.	0.50
	A1-N --> esc.	0.50
Area 2W	Noyes --> A1-T $\xrightarrow{*}$ A2W --> esc.	0.35
	A1-N --> A2W --> esc.	0.65
Area 2E South	Noyes --> A1-T --> A1-N $\xrightarrow{**}$ A2E-SK --> A2E-S --> esc.	0.20
	A2W $\xrightarrow{**}$ A2E-S --> esc.	0.30
	A2E-S --> esc.	0.50
Area 2E Skidegate	Noyes --> A1-T --> A1-N $\xrightarrow{**}$ A2E-SK --> esc.	0.35
	A2W $\xrightarrow{**}$ A2E-S --> A2E-SK --> esc.	0.15
	A2E-SK --> esc.	0.50

Table 5. Percentage of the catch in each chum fishery that is assumed to be of North Coast/Queen Charlotte Islands origin, by time period.

	Fishery									
	A1-T	A1-N	A2W	A2E	A3XY	A3Z	A4	A5	Noyes	C. Fox
--> mid June	0	0	0	0	20*	30*	20	10	10	10*
2nd half June	0	0	0	0	20*	30*	20	10	10	10*
1st half July	0	0	0	0	30*	50*	30	15	10	20*
2nd half July	0	0	0	0	50*	80*	50	25	5	30*
1st half August	0	0	0	0	50*	90*	50	50	5	30*
2nd half August	70	70	70	0	80*	90*	80	80	5	20*
1st half September	90	90	85	100	80*	90*	80	80	5	10*
mid September -->	100	100	100	100	80*	90*	80	80	5	10*

* The proportions of the catch in Area 3XY, Area 3Z and Cape Fox that is assumed to be of local origin is determined by multiplying the nominal values given above by the following year-specific factors:

Year	Factor
1970	0.982
1971	1.000
1972	1.043
1973	0.993
1974	1.250
1975	0.893
1976	1.500
1977	0.816
1978	1.045
1979	0.750
1980	0.793
1981	1.151
1982	1.009

Table 6. **Annual unexplained catch by fishery for Queen Charlotte Islands and North Coast chum fisheries.**

	Area 1 Troll	Area 1 Net	Area 2W	A2E South	A2E Skid	Area 3XY	Area 3Z	Area 4	Area 5	Noyes Is.	Cape Fox	Total Unexpl.	% Unexpl.
1970	0	0	1	0	0	10	3623	4	459	0	0	4096	0.57
1971	0	0	0	0	0	2333	5242	1	1	0	0	7577	1.49
1972	0	0	0	0	0	15	18320	15	65	0	28	18443	2.26
1973	0	0	0	0	0	57	3512	0	2	0	15	3586	0.45
1974	0	0	0	0	0	58	229	26	101	0	41	455	0.10
1975	0	0	0	0	0	2	851	2	87	0	0	942	1.17
1976	0	0	0	0	0	10	516	3	20	0	3	552	0.56
1977	0	0	0	0	0	2	2039	1	0	0	0	2042	0.52
1978	0	0	0	0	0	44	1939	0	214	0	0	2197	0.84
1979	0	0	0	0	0	2	1	1	334	0	0	338	0.42
1980	0	0	0	0	0	3	1	1	1	0	12	18	0.00
1981	0	0	0	0	0	7	2	0	293	0	0	302	0.30
1982	0	0	0	0	0	94	636	4	247	0	0	981	0.49

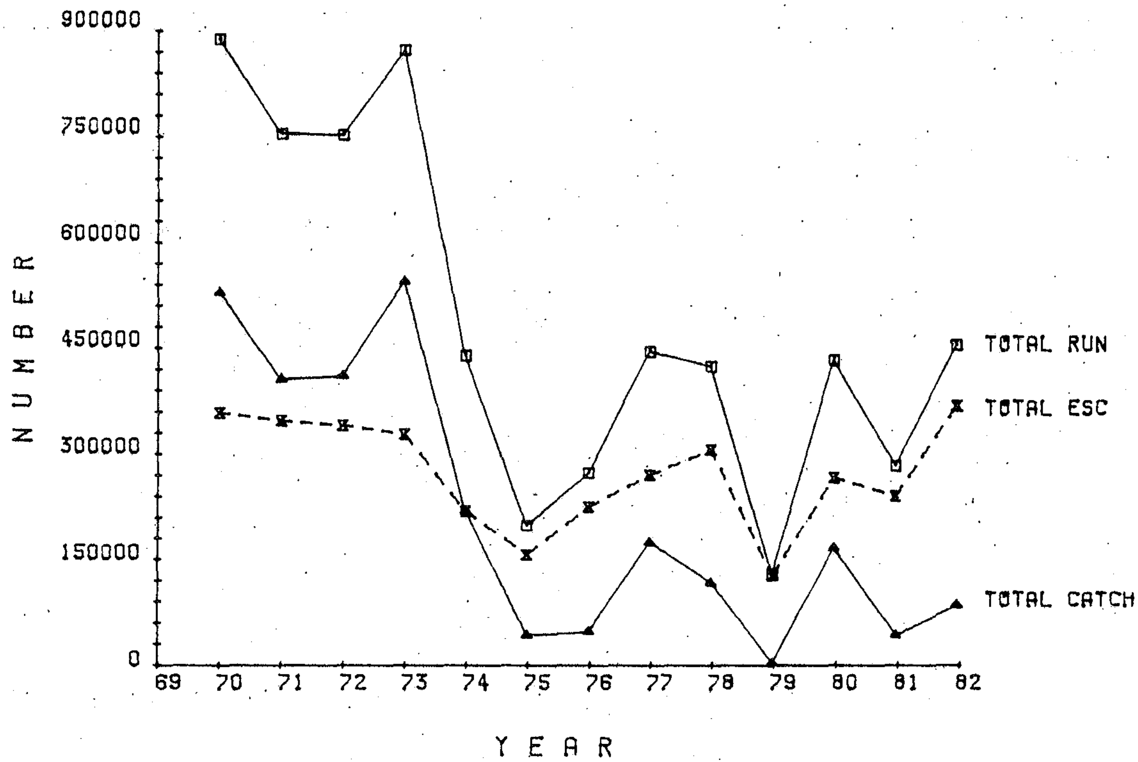


Fig. 3. Catch, escapement and total run size for Queen Charlotte Islands chum salmon, 1970 to 1982.

Area 1 Chum

The primary producers of chum salmon in Area 1 are the Ain River in Masset Inlet and the Naden River in Naden Harbour. By virtue of their contribution of approximately 70% of the Area 1 chum escapement, these stocks provide the focus for chum management in this area.

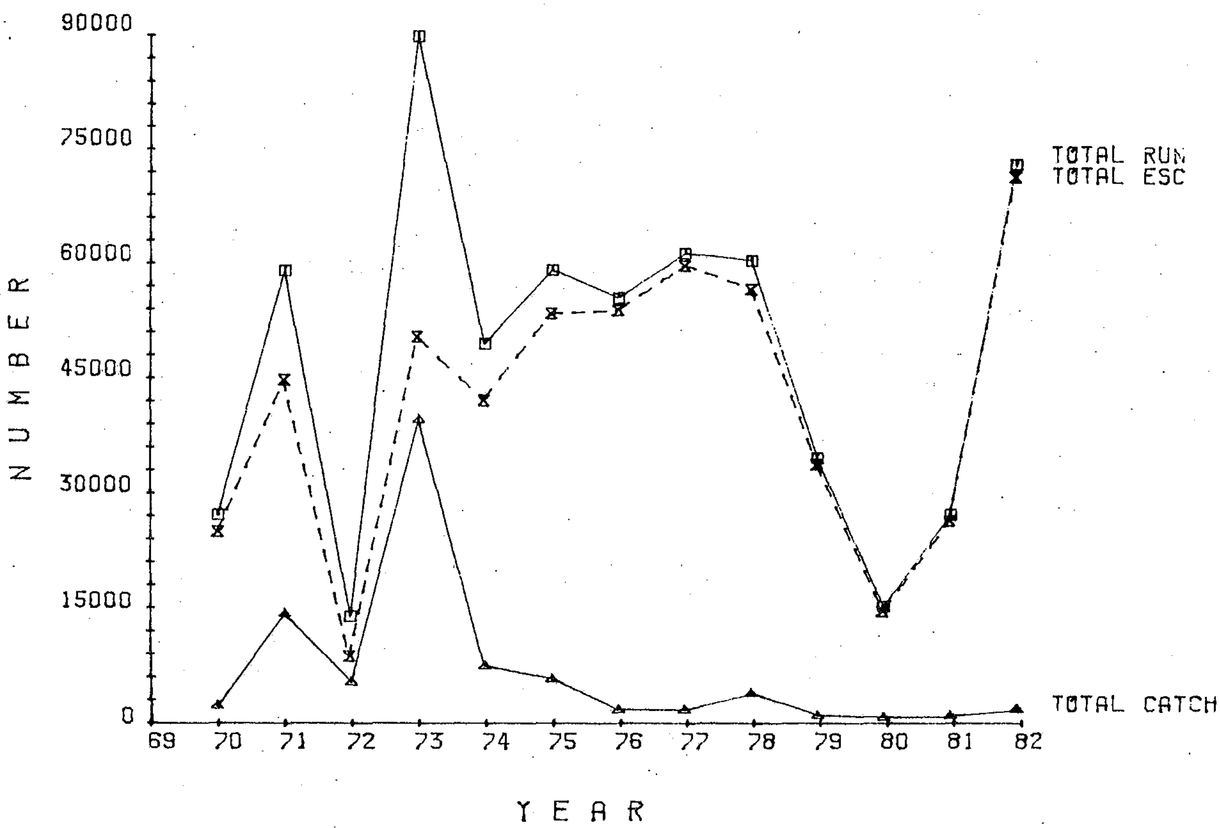
Escapements into Area 1 spawning streams occur between early September and late October, with a peak around the first of October. The quality of escapement estimates benefits from accessibility of the streams for foot surveys, which tends to be better in Area 1 than in most other parts of the Queen Charlotte Islands, but suffers from poor visibility in very turbid water conditions, due to a high level of leachates.

STOCK: AREA 1

YEAR	TOTAL RUN	TOTAL CATCH	TOTAL ESCAPE	HARVEST RATE	%CATCH NATIVE	%CATCH A1 TRL	%CATCH A1 NET	%CATCH NOYES
1970	26951	2151	24800	7.98	23.24	0.01	76.75	0.00
1971	58669	14169	44500	24.15	3.18	0.05	96.73	0.05
1972	13830	5230	8600	37.80	4.21	0.04	95.73	0.02
1973	89255	39255	50000	43.98	2.17	0.25	97.58	0.00
1974	49112	7312	41800	14.89	0.96	0.35	98.67	0.02
1975	58724	5674	53050	9.66	14.10	6.38	79.52	0.00
1976	55093	1593	53500	2.89	54.12	22.66	23.22	0.00
1977	60911	1611	59300	2.64	13.97	2.61	83.40	0.02
1978	59946	3746	56200	6.25	4.80	1.43	69.14	24.63
1979	34315	869	33446	2.53	89.78	10.22	0.00	0.00
1980	15084	630	14454	4.18	63.47	36.52	0.00	0.01
1981	26952	852	26100	3.16	88.03	11.68	0.29	0.00
1982	72480	1680	70800	2.32	59.51	32.63	0.00	7.85

Recent catches of Area 1 chum salmon have been significantly reduced from those of the early 1970's. This is due not to a decline in run sizes but to measures that have reduced the harvest rate from between 8% and 44% in the period 1970-1975 to rates of 2-6% thereafter. The total run size has been driven primarily by escapement levels; neither run nor escapement show any clear trend over time, but a sharp decline in the years 1979-1981 is of concern. Overall, there is no clear evidence that dramatic reductions in harvest rates have produced significant stock rebuilding; this may indicate inherently low productivity levels. In the early 1970's, the Area 1 net fishery dominated the harvest of Area 1 chum. More recently, the Native food fishery and the Area 1 troll fishery have taken a greater proportion of a much smaller total catch, due to reductions in targetted commercial net fisheries. The native component has reached 88-90% at some points, while the troll catch proportion has been as high as 32-36% in some years. Noyes Island is the other fishery assumed to impact on Area 1 chum, but its effect was significant only in 1978, when its harvest represented 25% of the total catch of this stock. Timing of Area 1 chum entering the region is centred on the 4th week of September.

Area 1 Chum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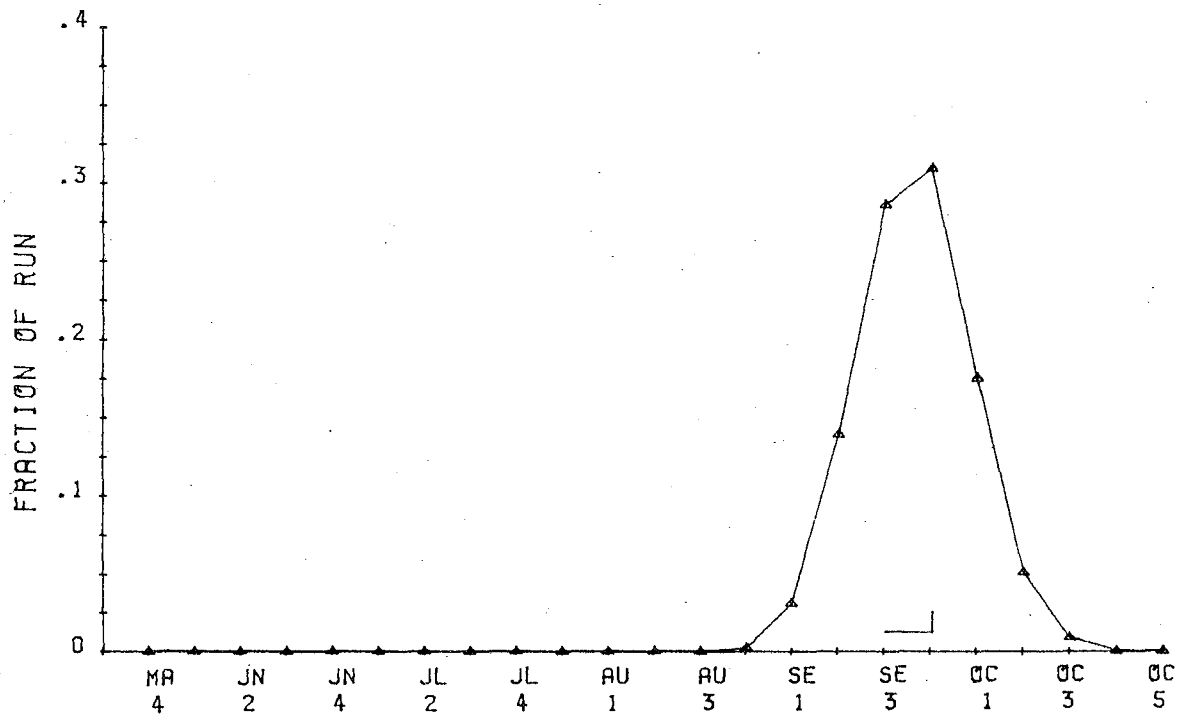
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Area 2W Chum

There are approximately 57 chum producing systems in Area 2W, of which the most important in recent years have been Tasu Creek, Seal Inlet and Louscoone Inlet Creek. The fiord-like geography of this region has created many natural terminal fishing areas for chum, resulting in the directed management of a larger number of stocks than in other areas.

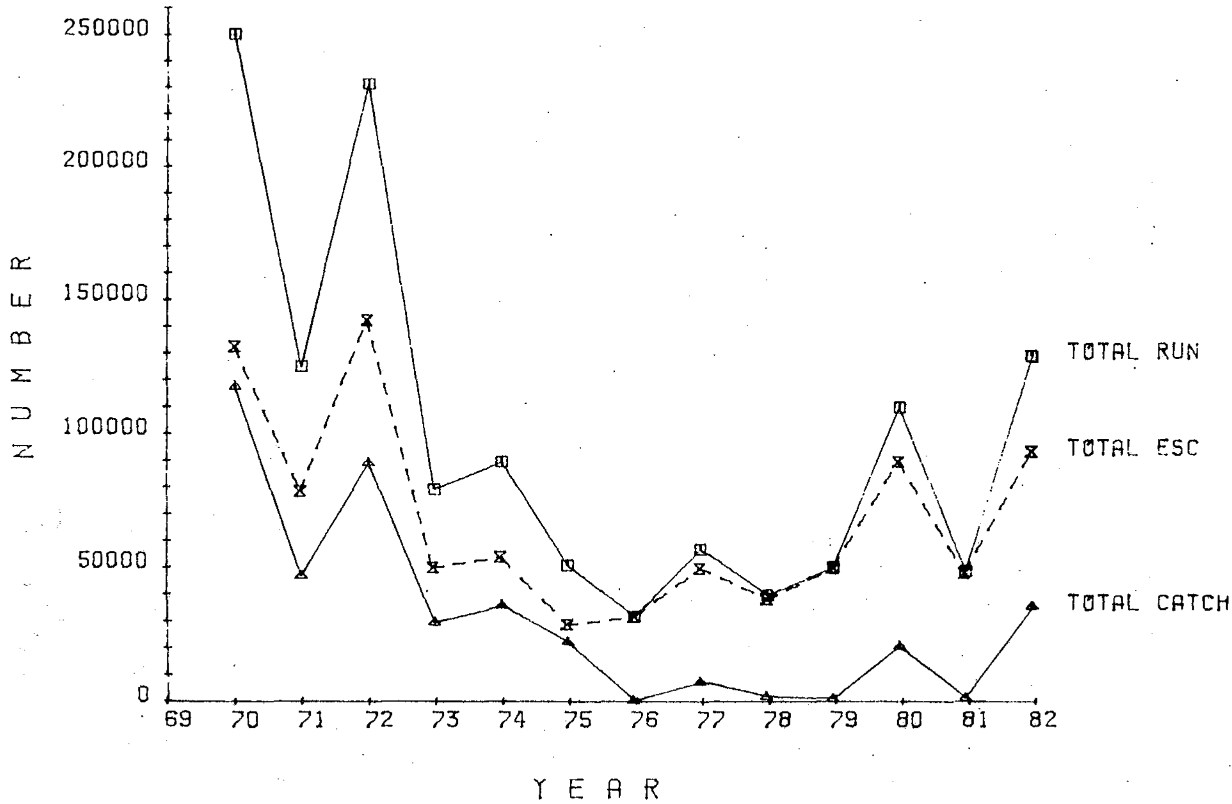
The timing of Area 2W chum stocks is somewhat earlier than that of other Queen Charlotte Islands chum runs, with peak escapements into the spawning systems occurring around the 3rd week of September. The remoteness of most Area 2W streams (apart from the Skidegate West area) limits the quality of escapement estimates, and has led to a greater use of fixed-wing aircraft for enumeration compared with other areas. Observability tends to be variable, with considerable turbidity in the north and clearer conditions in the south.

STOCK: AREA 2W

YEAR	TOTAL RUN	TOTAL CATCH	TOTAL ESCAPE	HARVEST RATE	%CATCH A1 TRL	%CATCH A1 NET	%CATCH AREA 2W	%CATCH NOYES
1970	250426	117700	132726	47.00	0.01	1.75	98.22	0.02
1971	125297	46817	78480	37.36	0.03	1.48	97.80	0.68
1972	231719	89219	142500	38.50	0.01	4.28	94.93	0.77
1973	79383	29433	49950	37.08	0.05	4.53	95.40	0.02
1974	89799	35973	53826	40.06	0.08	3.77	95.45	0.70
1975	50880	22130	28750	43.49	0.17	5.58	94.25	0.00
1976	31624	46	31578	0.15	8.40	16.76	46.01	28.83
1977	56833	7111	49722	12.51	0.33	1.64	97.61	0.42
1978	39712	1569	38143	3.95	5.68	13.28	79.39	1.66
1979	50371	764	49607	1.52	45.54	0.00	54.29	0.16
1980	110126	20419	89707	18.54	2.28	0.12	96.95	0.64
1981	48971	1045	47926	2.13	16.93	65.72	14.04	3.31
1982	129025	35562	93463	27.56	0.42	0.00	91.65	7.92

Runs, catches and escapements of Area 2W chum salmon declined considerably between 1970 and 1976, but have increased somewhat since that time. Harvest rates of 37-47% over the period 1970-1975 have been reduced significantly, reaching negligible levels in several years between 1976-1981. The catch of Area 2W chum is harvested almost entirely terminally, except in years of low abundance when incidental catches in interception fisheries are proportionately greater. The results show that Area 2W chum have been "managed to abundance" in the terminal fishery, with catches dependent on the existence of harvestable surpluses. The harvest rates of the early 1970's appear to have been excessive, and reductions in these rates have led to some rebuilding of the stock. The entering run of Area 2W chum peaks in the second week of September, with a fairly low level of variability.

Area 2W Chum



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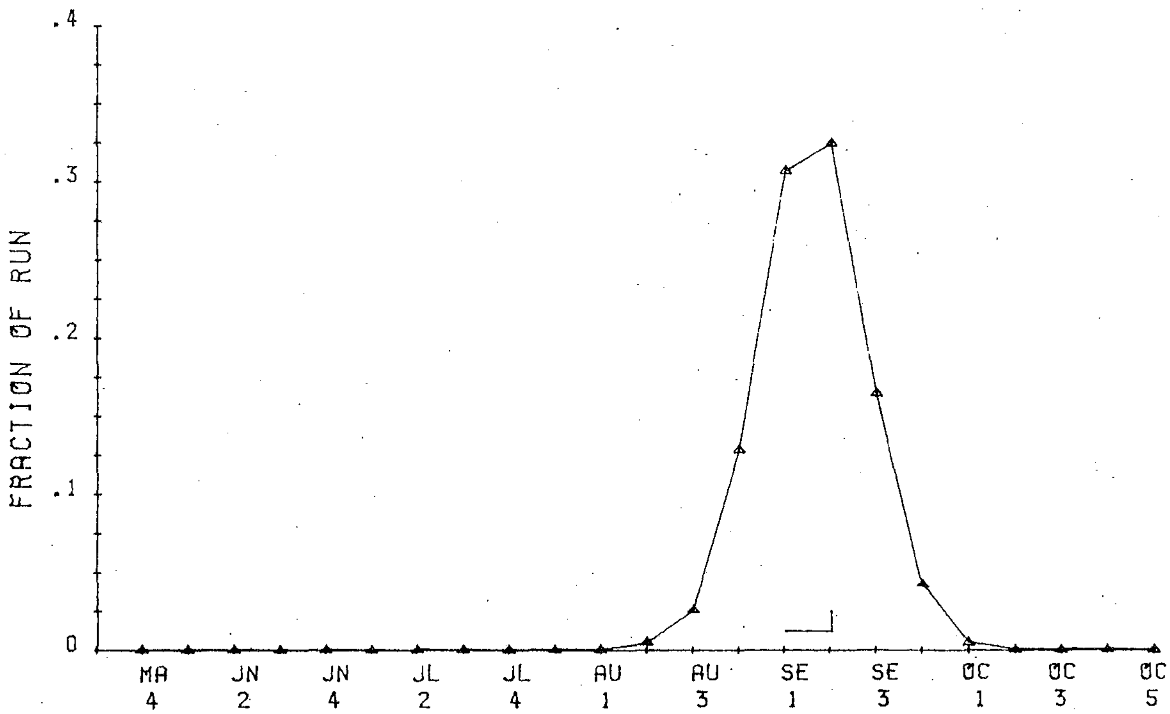

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Area 2E South Chum

This stock group includes all chum salmon stocks originating in Area 2E south of Skidegate Inlet. The sub-areas of primary importance in this region include: Cumshewa, Selwyn, Atli, Darwin, Juan Perez and Skincuttle, each of which is composed of many small chum producing rivers and creeks. Pallant Creek in Cumshewa Inlet and Lagoon Creek in Selwyn Inlet are the largest of these streams.

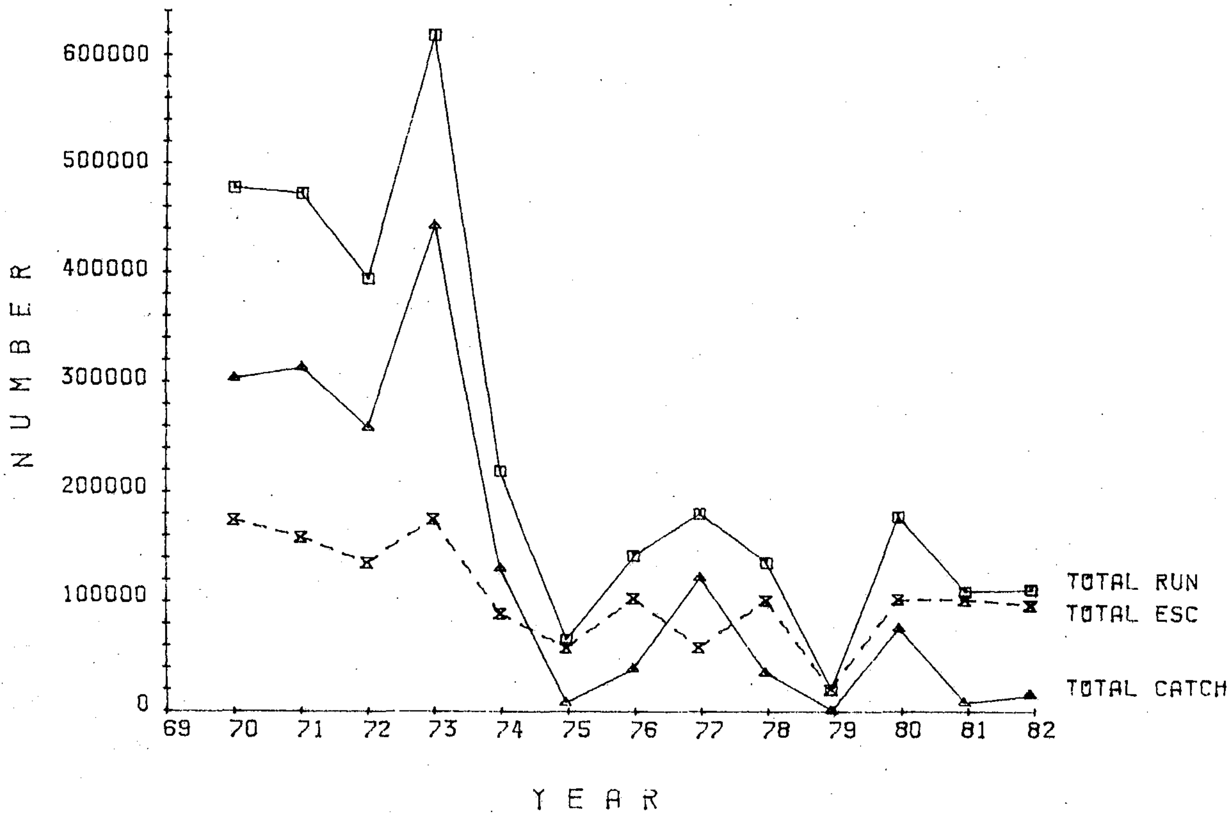
Escapement past the terminal fisheries occurs between early September and late October, with a peak in early October. While reasonably good escapement estimates are available for the Cumshewa and Pallant Creek stocks, the remainder of this stock grouping must be surveyed by air or by boat, and hence overall escapement estimates are of uncertain quality.

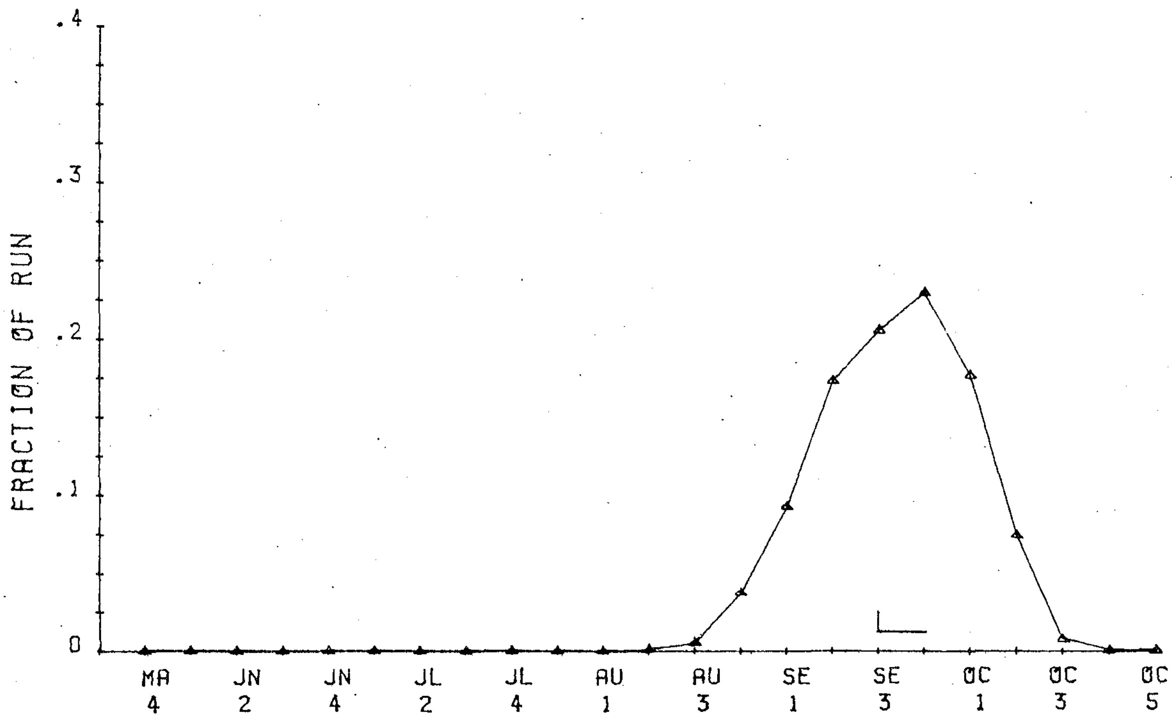
STOCK: AREA 2E SOUTH

YEAR	TOTAL RUN	TOTAL CATCH	TOTAL ESCAPE	HARVEST RATE	%CATCH A1 TRL	%CATCH A1 NET	%CATCH AREA 2W	%CATCH A2E-S	%CATCH A2E-SK	%CATCH NOYES
1970	482127	306323	175804	63.54	0.01	1.01	11.23	70.32	17.38	0.05
1971	477181	316906	160275	66.41	0.01	0.72	10.74	86.65	1.74	0.14
1972	398621	261861	136760	65.69	0.01	1.14	11.17	81.21	6.23	0.25
1973	625026	447988	177038	71.68	0.02	0.57	7.32	89.34	2.75	0.00
1974	221513	131640	89873	59.43	0.03	1.57	11.28	78.02	8.55	0.55
1975	65883	7655	58228	11.62	0.57	8.56	89.73	1.14	0.00	0.00
1976	143360	39160	104200	27.32	0.05	0.05	0.13	96.82	2.89	0.07
1977	182898	123688	59210	67.63	0.02	0.02	3.43	94.12	2.40	0.01
1978	137328	35114	102214	25.57	0.41	1.01	4.38	57.58	36.36	0.25
1979	19465	265	19200	1.36	21.92	0.00	8.81	69.26	0.00	0.01
1980	179521	76621	102900	42.68	0.49	0.00	14.14	59.65	25.69	0.03
1981	110274	7574	102700	6.87	2.55	2.29	1.39	0.28	93.29	0.20
1982	112647	14797	97850	13.14	0.62	0.00	67.33	4.53	20.62	6.90

While escapements of Area 2E South chum salmon have clearly decreased over the time frame of the analysis, the severity of this decline is considerably less than that of the total run size, due to drastic reductions in terminal catch levels. Since 1975, total run and escapement levels have remained fairly stable, although at a lower equilibrium than that which existed prior to 1974. Indeed, there appears to have been a clear drop in overall productivity, so that a stable, low harvest rate no longer supports the run sizes or escapements that previously existed at higher harvest rates. The combined Area 2E fishery was responsible for at least 87% of the total catch in every year except 1975 and 1982, when the Area 2W fishery dominated the catch. Noyes Island and Area 1 fisheries contributed to the catch on a sporadic and variable basis. On average, 50% of the run enters the study area (at Noyes, Area 2W or terminally) by the third week of September; almost all of the run enters over the period between mid-August and mid-October.

<u>Area 2E South Chum</u>





Area 2E Skidegate Chum

Due to its location and intrinsic importance, as well as differences in escapement timing and migration routing compared with southern Area 2E chums, the Skidegate stock grouping is treated separately in the reconstruction analysis. Major component stocks in the Skidegate system include Deena River, Lagins Creek, Honna River, Slatechuck Creek and Tarundl Creek.

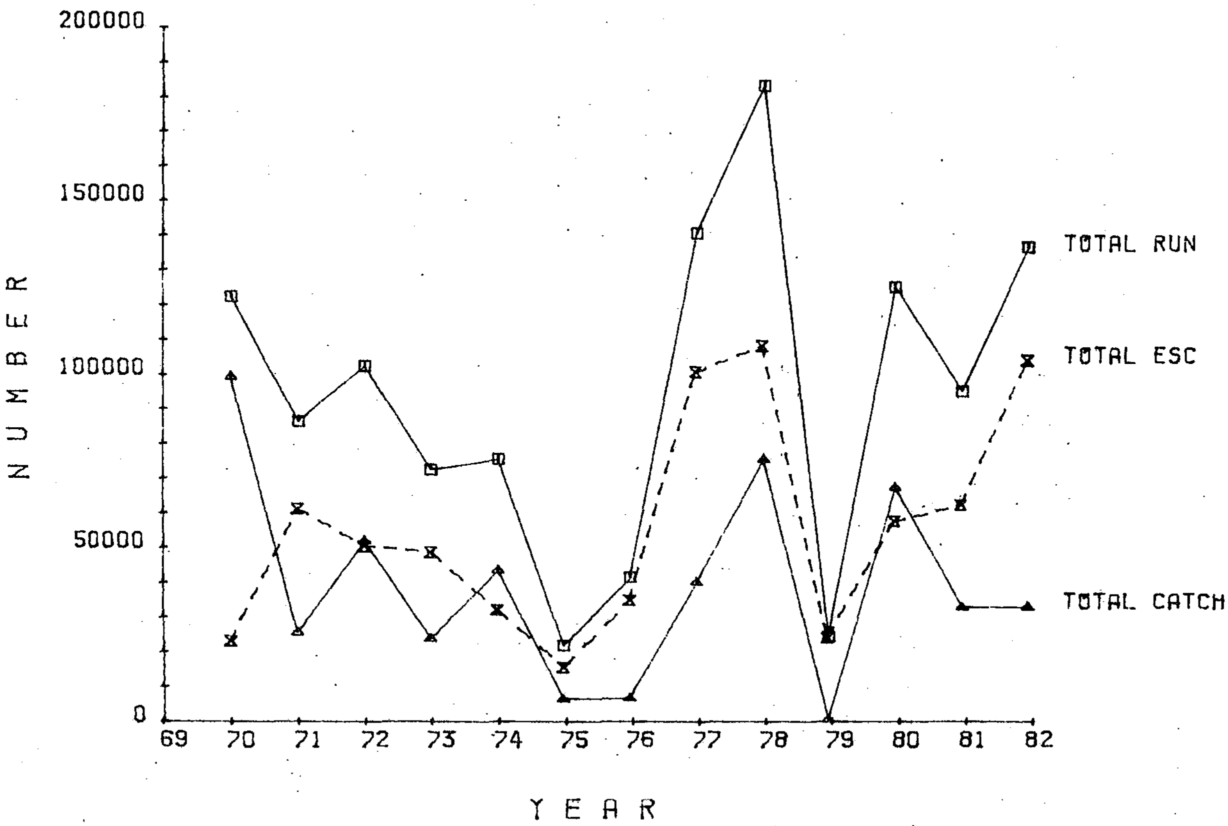
The Skidegate chum run escapes from the terminal fisheries between late August and late October, with a peak in late September. Of the Queen Charlotte Islands stock groupings considered in this analysis, escapements for Skidegate chum are likely the most accurately enumerated, due to their general accessibility.

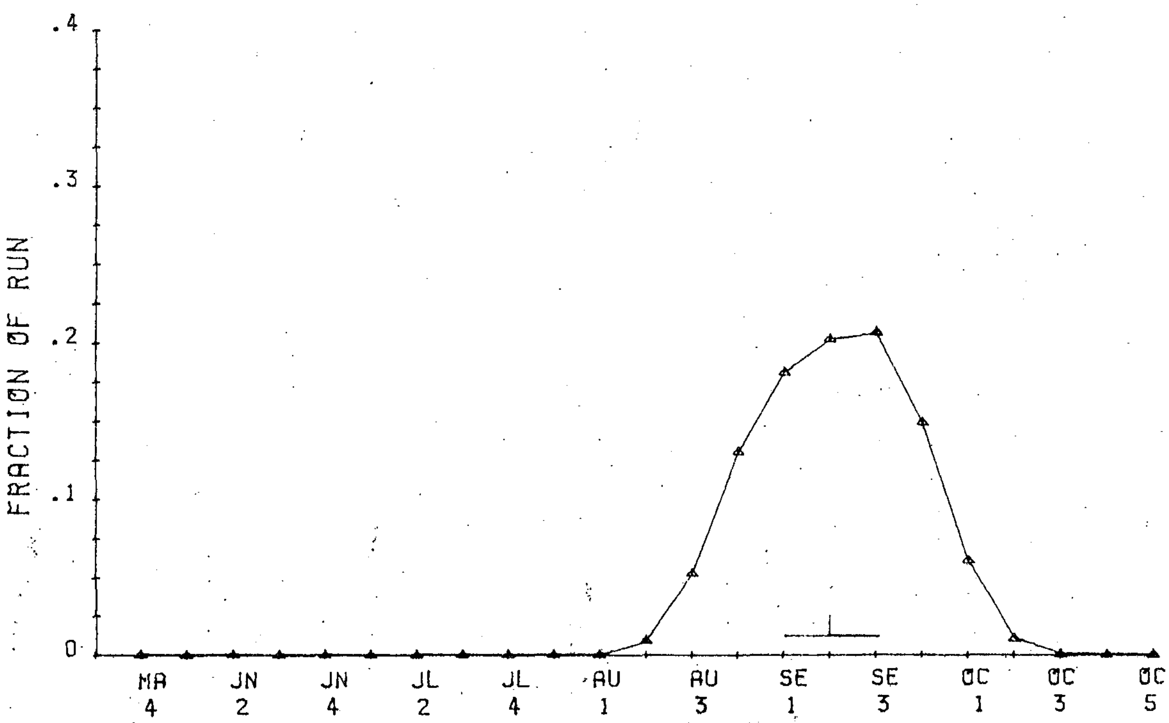
STOCK: AREA 2E SKIDEGATE

YEAR	TOTAL RUN	TOTAL CATCH	TOTAL ESCAPE	HARVEST RATE	%CATCH NATIVE	%CATCH A1 TRL	%CATCH A1 NET	%CATCH AREA 2W	%CATCH A2E-S	%CATCH A2E-SK	%CATCH NOYES
1970	122429	99255	23174	81.07	0.14	0.00	0.20	12.88	30.62	56.17	0.00
1971	86583	25456	61127	29.40	0.00	0.05	1.14	8.88	23.81	65.11	1.00
1972	102317	51873	50444	50.70	0.09	0.01	1.40	11.47	20.87	65.69	0.47
1973	72488	23801	48687	32.83	4.14	0.08	2.99	17.33	27.24	48.18	0.03
1974	75559	43527	32032	57.61	2.81	0.04	1.04	19.94	17.50	58.24	0.43
1975	21793	6288	15505	28.85	7.95	0.26	5.89	85.83	0.06	0.00	0.00
1976	41392	6592	34800	15.92	10.24	0.07	0.07	0.03	70.93	18.44	0.23
1977	140692	40077	100615	28.49	2.25	0.12	0.32	1.81	46.32	49.03	0.15
1978	183410	75471	107939	41.15	0.27	0.47	0.42	0.68	8.62	89.44	0.10
1979	24405	451	23954	1.85	0.00	36.84	0.00	46.37	16.66	0.00	0.14
1980	124988	67305	57683	53.85	2.44	0.65	0.01	11.63	0.66	84.48	0.13
1981	94964	32738	62226	34.47	4.22	1.05	1.50	1.74	0.01	91.27	0.22
1982	136593	32888	103705	24.08	1.52	0.52	0.00	10.08	0.32	78.01	9.56

The Skidegate component of Area 2E chum shows wide variability in total run size over the period 1970-1982. Overall, escapement levels show some increase over time, while catches have been fairly stable. Apart from 1970, when the catch was relatively high and the escapement rather low, harvest rates have been moderate, ranging from a low of 0 in the poor year of 1979 to a high of 58% in 1974. Since 1975, the terminal area harvest rate appears to have been managed to abundance, particularly in noticeably good or bad years. The terminal net fishery in Skidegate typically has been the principal harvester of Area 2E Skidegate chum, except for 1975, 1976 and 1979 when the Area 2W, Area 2E South and Area 1 Troll/Area 2W fisheries dominated, respectively. The Indian food fish catches have been a fairly small component of total harvest, as has the Noyes Island harvest, apart from 1982 when 10% of the catch of Area 2E Skidegate chum was obtained there. The entering run timing of Area 2E Skidegate chum stocks is centred on the second week of September, with year-to-year variability of one week on either side of this date.

Area 2E Skidegate Chum





North Coast

This area, comprising statistical areas 3-5, encompasses the drainages of the Nass and Skeena Rivers and the adjacent coastal area stretching from the U.S./Canada border to the southernmost tips of Pitt and Banks Islands. The Skeena and Nass Rivers are the second and third largest B.C. rivers respectively, with their entire length in B.C. The coastal portion of Area 3 and 4 is characterized by an outer chain of islands surrounding Chatham Sound, a large open body of water. Area 5 is a more complex series of islands and channels (Fig. 4).

Chum production on the North Coast is found in each of the three statistical areas, but Area 3 is the largest producer, with Areas 4 and 5 generating somewhat lesser numbers. Optimal escapements for these areas are estimated as follows: 90,000 for Area 3; 50,000 for Area 4; and 35,000 for Area 5. These escapement goals have been met only rarely over the past 40 years, with Area 4 being the most severely depressed in recent years.

The chum stocks in Area 3 have been divided into three aggregations for the purpose of this study, according to geographical and timing differences (Table 7). The Late Run stock is composed of streams in the Kshwan system, but may also represent the late run component of the Khutzeymateen stock. Timing of the escapement to these spawning streams has been estimated by the Area 3 fishery officer, and ranges from late July to early September, with a peak in the 3rd week of August, fully six weeks later than other Area 3 chum stocks. The Observatory Inlet stock group includes all stocks in the inlet, apart from the Kshwan, while the Portland/Nass stock group includes all other chum producing systems in Area 3, located predominately in Portland Inlet and the Nass system. The Observatory Inlet and the Portland/Nass stock groups are assumed to have identical escapement timing, ranging from mid-June to mid-August with a peak in the 2nd week of July.

Chum stocks in Area 4 are treated as a single unit, as are those of Area 5, due to the relatively low stock sizes in these areas and the lack of major timing differences between component stocks. Area 4 escapement timing has been estimated using Skeena River test fishery data, which indicates a peak in mid-August. Area 5 timing represents fishery officer estimates, with escapement occurring from late July to late September and peaking in mid-August. For lack of complete information, escapement timing for all North Coast stocks has been assumed to be invariant from year to year over the time period of the analysis.

Escapements for each of the above stock groups have been determined by appropriate summations of stock-by-stock escapement values recorded in the North Coast Management Biology Unit. Since chum salmon spawn somewhat later in the season, on average, than do pink and sockeye, the amount of effort that is available for escapement enumeration is often limited by funding constraints or other committments. In the case of the Area 3 Kshwan chum stock, for example, the largest component of the stock spawns late in the season and apparently was only "discovered" by accident in the mid-1970's. Hence prior to this point, escapement estimates for this system may represent only a small earlier-spawning component (B. Huber, pers. comm.).

North Coast chum stocks are assumed to approach their respective terminal area fisheries from the north (via major fisheries at Noyes Island and Cape Fox in Alaska), from the west (past the Langara Island fishery of Area 1) and from the south (via Hecate Strait). A list of the prinicipal fisheries, their major gear types and typical timing of the harvest is presented in Table 8. Note that, although the Area 1 Troll fishery harvests a very limited number of chum salmon, it has been explicitly included in the analysis for the sake of completeness and to ensure comparability with sockeye and pink reconstruction results (Starr et. al., 1984, and Henderson & Charles, 1984, respectively).

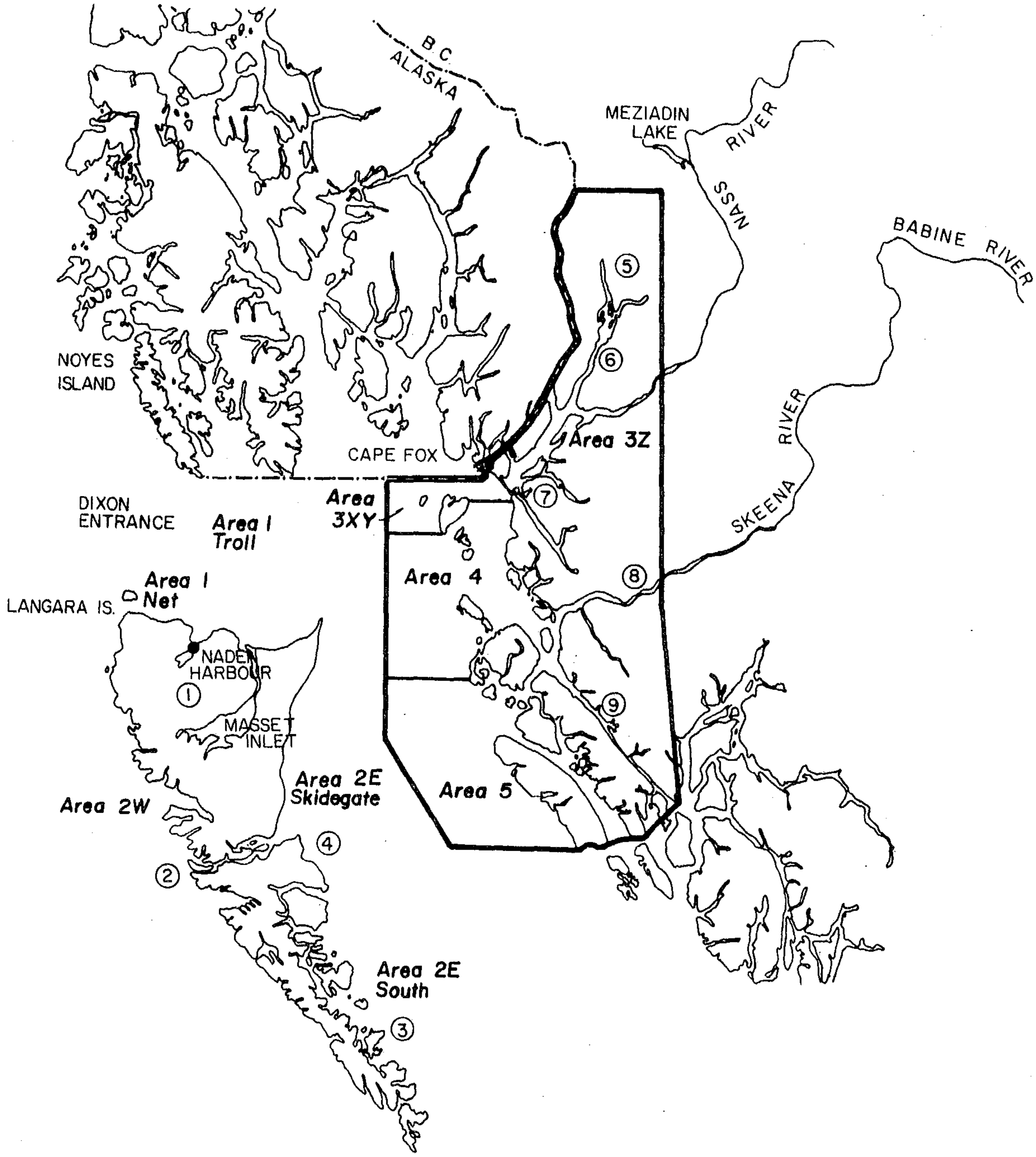
Each Area 3 chum stock is assumed to split between three migration routes through the Alaskan, Queen Charlotte Islands and North Coast fisheries according to the above north/west/south designation, although the southern approach is simply via Area 4, without any preceding fisheries (Table 9). The chum stocks of Areas 4 and 5 are assumed to split similarly between north/west/south routes, with the northern approach to Area 5 being via Area 4 and the southern approach to Area 4 passing through Area 5. The proportion of each stock that utilizes each migration route is assumed not to vary from year to year, since there is no quantitative evidence to the contrary.

"Proportion local" factors (Table 10) have been used in this analysis to decrease the total catch in a given fishery by a factor representing the fraction of that catch that is estimated to be of 'local' origin (i.e. originating either on the North Coast or on the Queen Charlotte Islands). These factors vary with the time period within the fishing season, and represent the best combined estimate of biologists experienced with the fisheries.

While in general there is insufficient information available to derive year-to-year changes in these "proportion local" estimates, in the case of Area 3 and Cape Fox fisheries where Alaskan and Canadian stocks intermingle, it proved important in the analysis to allow for variations on an annual basis. To accomplish this, the ratio of Area 3 escapement to Portland Canal (Alaska) escapement was calculated for each year. The median of these ratios was determined, and in each year the difference between the median and the ratio (A3/PC) for that year was used to generate an adjustment factor to be applied to the Cape Fox, Area 3XY and Area 3Z proportion local factors for that year. Hence, the Canadian proportion of the catches is increased in years for which the A3/PC ratio is unusually high, and conversely (Table 10).

The general question of interception levels is discussed in greater detail in the Queen Charlotte Islands section of this document, as is the occurrence of 'unexplained catch' in the analysis, due to year-to-year variability in timing, diversion rates and proportion local in each fishery. These unaccounted-for catches, which produce discrepancies between the catch figures used here and those found in the published catch statistics, are shown in Table 11.

The aggregated run, catch and escapement results for the North Coast (Areas 3-5), obtained by summing the 5 stock aggregations described below, are shown in Fig. 5. Apart from the particularly good years of 1972-1974, no strong trends are evident, although some deterioration in escapement levels is evident in recent years.



1 AREA 1	6 AREA 3 OBSERVATORY INLET
2 AREA 2W	7 AREA 3 PORTLAND/NASS
3 AREA 2E SOUTH	8 AREA 4
4 AREA 2E SKIDEGATE	9 AREA 5
5 AREA 3 LATE RUN	

Fig. 4. The major chum salmón stocks (circled numerals) and chum salmon fisheries (boldface type) in the Queen Charlotte Islands / North Coast region.

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Table 7. Stock groups and terminal area run timing for North Coast chum stocks.

Stock	Escapement Timing		
	Start	Peak	End
Area 3 Late Run (Kshwan)	late July	3rd week August	mid September
Area 3 Observatory Inlet	mid June	2nd week July	mid August
Area 3 Portland/Nass	mid June	2nd week July	mid August
Area 4	early-mid July	2nd week August	late September
Area 5	late July	2nd week August	late September

Table 8. Gear type and sockeye catch timing for the major fisheries harvesting North Coast chum stocks.

Fishery	Gear Type	Catch Timing Start	Peak	End
Noyes Island, Alaska	seine	early July	mid July-mid August	early September
Cape Fox, Alaska	seine	mid June	late July-early August	mid September
Area 1 Troll (A1-T)	troll	mid August	mid August	early October
Area 1 Net (A1-N)	seine	mid August	highly variable	mid October
Area 3X,3Y (A3XY)	seine, gillnet	early June	mid July-early August	late September
Area 3Z (A3Z)	seine, gillnet	early June	mid July-mid August	late September
Area 4 (A4)	seine, gillnet	early July	late July-early August	late September
Area 5 (A5)	seine, gillnet	early July	August	mid September

Table 9. **Migration routes and diversion rates for major North Coast chum stock groups. (Migration time between fisheries is 1/2 week except 1 week where indicated by *)**

Stock Name	Routing by Fishery	Proportion of Stock Utilizing each Route
Area 3 Late Run (Kshwan) Area 3 Observatory Inlet Area 3 Portland/Nass		
	Noyes --> A1-T --> Cape Fox --> A3XY -->A3Z --> esc.	0.35
	A1-N --> A1-T $\overset{*}{\text{-->}}$ A3XY --> A3Z --> esc.	0.40
	A4 --> A3XY --> A3Z --> esc.	0.25
Area 4		
	Noyes --> A1-T --> Cape Fox --> A3XY --> A4 --> esc.	0.35
	A1-N --> A1-T $\overset{*}{\text{-->}}$ A4 --> esc.	0.45
	A5 --> A4 --> esc.	0.20
Area 5		
	Noyes --> A1-T $\overset{*}{\text{-->}}$ A4 --> A5 --> esc.	0.25
	A1-N --> A1-T $\overset{*}{\text{-->}}$ A5 --> esc.	0.50
	A5 --> esc.	0.25

Table 10. Percentage of the catch in each chum fishery that is assumed to be of North Coast/Queen Charlotte Islands origin, by time period.

	Fishery									
	A1-T	A1-N	A2W	A2E	A3XY	A3Z	A4	A5	Noyes	C. Fox
--> mid June	0	0	0	0	20*	30*	20	10	10	10*
2nd half June	0	0	0	0	20*	30*	20	10	10	10*
1st half July	0	0	0	0	30*	50*	30	15	10	20*
2nd half July	0	0	0	0	50*	80*	50	25	5	30*
1st half August	0	0	0	0	50*	90*	50	50	5	30*
2nd half August	70	70	70	0	80*	90*	80	80	5	20*
1st half September	90	90	85	100	80*	90*	80	80	5	10*
mid September -->	100	100	100	100	80*	90*	80	80	5	10*

* The proportions of the catch in Area 3XY, Area 3Z and Cape Fox that is assumed to be of local origin is determined by multiplying the nominal values given above by the following year-specific factors:

Year	Factor
1970	0.982
1971	1.000
1972	1.043
1973	0.993
1974	1.250
1975	0.893
1976	1.500
1977	0.816
1978	1.045
1979	0.750
1980	0.793
1981	1.151
1982	1.009

Table 11. Annual unexplained catch by fishery for Queen Charlotte Islands and North Coast chum fisheries.

	Area 1 Troll	Area 1 Net	Area 2W	A2E South	A2E Skid	Area 3XY	Area 3Z	Area 4	Area 5	Noyes Is.	Cape Fox	Total Unexpl.	% Unexpl.
1970	0	0	1	0	0	10	3623	4	459	0	0	4096	0.57
1971	0	0	0	0	0	2333	5242	1	1	0	0	7577	1.49
1972	0	0	0	0	0	15	18320	15	65	0	28	18443	2.26
1973	0	0	0	0	0	57	3512	0	2	0	15	3586	0.45
1974	0	0	0	0	0	58	229	26	101	0	41	455	0.10
1975	0	0	0	0	0	2	851	2	87	0	0	942	1.17
1976	0	0	0	0	0	10	516	3	20	0	3	552	0.56
1977	0	0	0	0	0	2	2039	1	0	0	0	2042	0.52
1978	0	0	0	0	0	44	1939	0	214	0	0	2197	0.84
1979	0	0	0	0	0	2	1	1	334	0	0	338	0.42
1980	0	0	0	0	0	3	1	1	1	0	12	18	0.00
1981	0	0	0	0	0	7	2	0	293	0	0	302	0.30
1982	0	0	0	0	0	94	636	4	247	0	0	981	0.49

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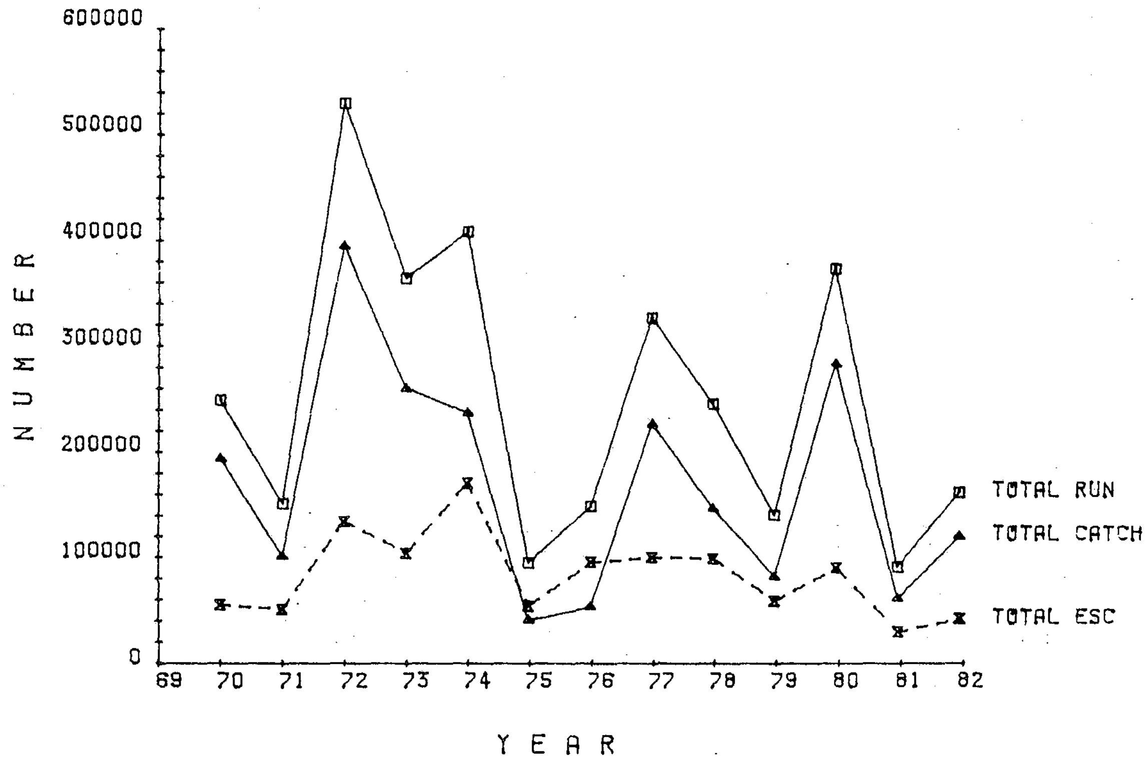


Fig. 5. Catch, escapement and total run size for North Coast chum salmon, 1970 to 1982.

Area 3 Late Run Chum

The Kshwan River chum stock is the predominant contributor to this stock group. While the Kshwan includes both early and late run components, the latter represents approximately 80% of the total escapement, which serves to differentiate this stock from others in Area 3. It appears, however, that prior to the mid-1970's the late run escapement may not have been fully enumerated. This, combined with the lack of tagging analysis on Area 3 chum stocks and the consequent imprecision in "proportion local" factors, creates considerable uncertainty regarding the historical pattern for this stock. In addition, glacial silt makes the Kshwan stock difficult to assess, so that the accuracy of escapement estimates may be limited. In years when prior harvest rates in the mixed stock Portland Inlet fishery and the intercepting U.S. fisheries are insufficient to harvest the available surplus, "clean-up" fisheries can be held on this stock very late in the season (late August).

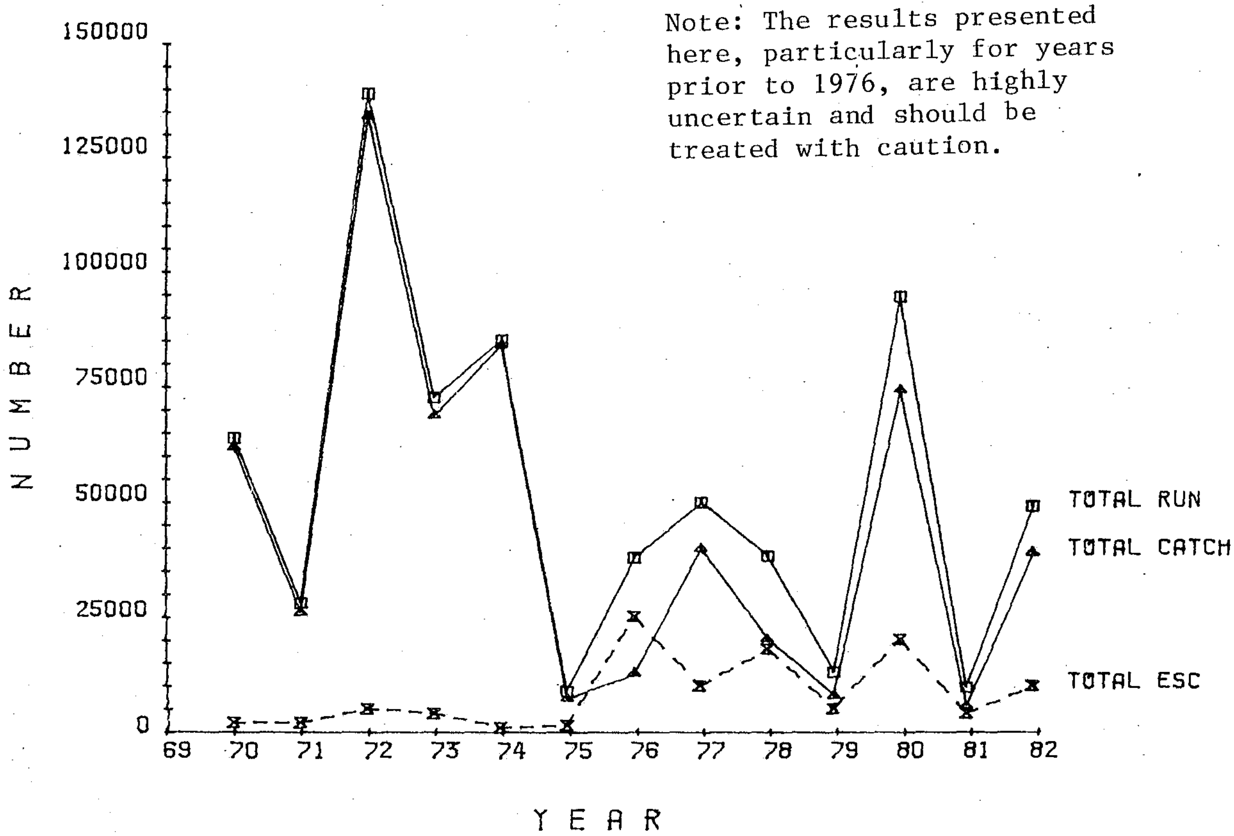
STOCK: AREA 3 LATE RUN

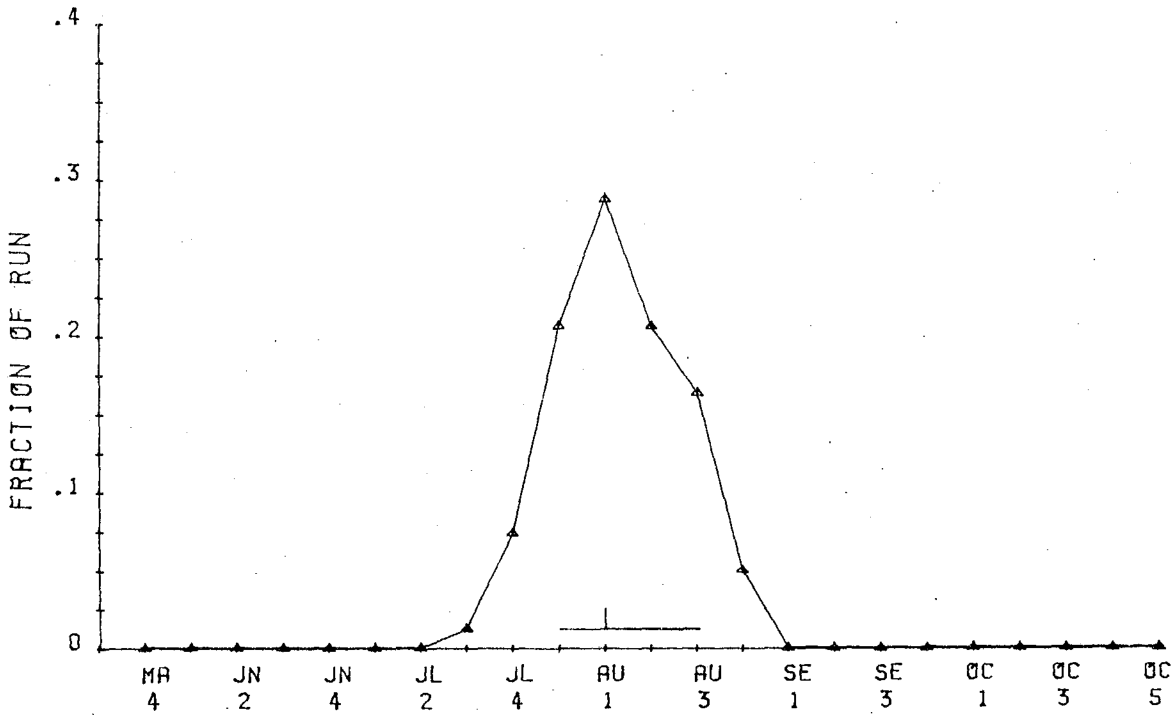
YEAR	TOTAL RUN	TOTAL CATCH	TOTAL ESCAPE	HARVEST RATE	%CATCH NATIVE	%CATCH A1 TRL	%CATCH A1 NET	%CATCH AR 3XY	%CATCH AR 3Z	%CATCH AREA 4	%CATCH NOYES	%CATCH C.FOX
1970	63500	61500	2000	96.85	0.08	0.01	0.68	19.80	59.90	11.43	0.50	7.59
1971	27844	25844	2000	92.82	0.03	0.13	3.40	16.00	51.94	23.73	2.94	1.83
1972	138161	133161	5000	96.38	0.03	0.01	1.25	4.89	67.24	18.26	2.49	5.83
1973	72313	68313	4000	94.47	0.07	0.02	1.68	2.73	76.28	12.51	1.16	5.55
1974	84614	83614	1000	98.82	0.01	0.01	0.47	1.04	84.32	2.53	1.50	10.13
1975	8717	7217	1500	82.79	0.29	0.04	0.05	6.59	56.45	16.21	0.01	20.36
1976	37635	12635	25000	33.57	2.72	0.05	0.00	23.65	49.17	9.91	2.80	11.70
1977	49657	39657	10000	79.86	0.49	0.09	0.77	16.71	58.47	16.89	1.10	5.47
1978	37979	19979	18000	52.61	0.89	0.10	0.01	42.23	25.22	13.17	1.86	16.51
1979	12831	7831	5000	61.03	2.38	0.90	0.00	33.90	25.33	34.22	1.01	2.26
1980	93925	73925	20000	78.71	0.50	0.45	0.36	19.06	61.44	4.54	4.27	9.38
1981	9530	5530	4000	58.05	2.44	0.13	0.38	3.69	43.35	23.09	8.13	18.80
1982	48756	38756	10000	79.49	0.82	0.31	0.00	24.92	36.52	11.83	8.52	17.08

An examination of the escapement and harvest rate time series for the Area 3 Late Run chum stock shows the dominant feature of the results for this stock. In the period up to 1975, apparent escapements to the Kshwan system were very low, while Area 3 catches with comparably late timing were very high. Hence the computed harvest rate on this stock lies between 92-98% for 1970-1974 and 83% for 1975, levels which are clearly exaggerated. This result is likely due to a combination of factors, including underestimation of late-run Kshwan escapements prior to 1976, and possible overestimation of the proportion local in late-season Area 3 catches for some years. In any case, these results indicate the uncertainty in input parameters and data, and should not be seen as an indication of unreasonably high harvest rates. After 1975, escapements have been fairly stable, with a slight declining trend. Runs and catches have fluctuated considerably, while harvest rates have ranged between 33 and 80%. The harvest rate shows little response to abundance, since the mixed stock fisheries in which Area 3 Late Run chum are caught are not actively managed for this stock. The Area 3Z fishery is the most substantial contributor to catch, but substantial harvests are also taken in Area 3XY and Area 4, as well as Noyes Island and Cape Fox. The Area 1 troll and net fisheries and the Area 3 native food fishery take limited numbers of the catch. The peak of the entering run of Area 3 Late Run chum coincides with the 50% mark, in the first week of August, but there is a spread of 3 weeks possible in this timing.

Area 3 Late Run Chum

Note: The results presented here, particularly for years prior to 1976, are highly uncertain and should be treated with caution.





Area 3 Observatory Inlet Chum

The Dak, Illiance and Kitsault Rivers, together with Stagoo Creek, comprise a stock group that can be managed directly in a near-terminal location. As with the Late Run (Kshwan) stock, significant harvest is taken from these stocks before they enter Observatory Inlet, resulting in sporadic and unpredictable surpluses in terminal areas.

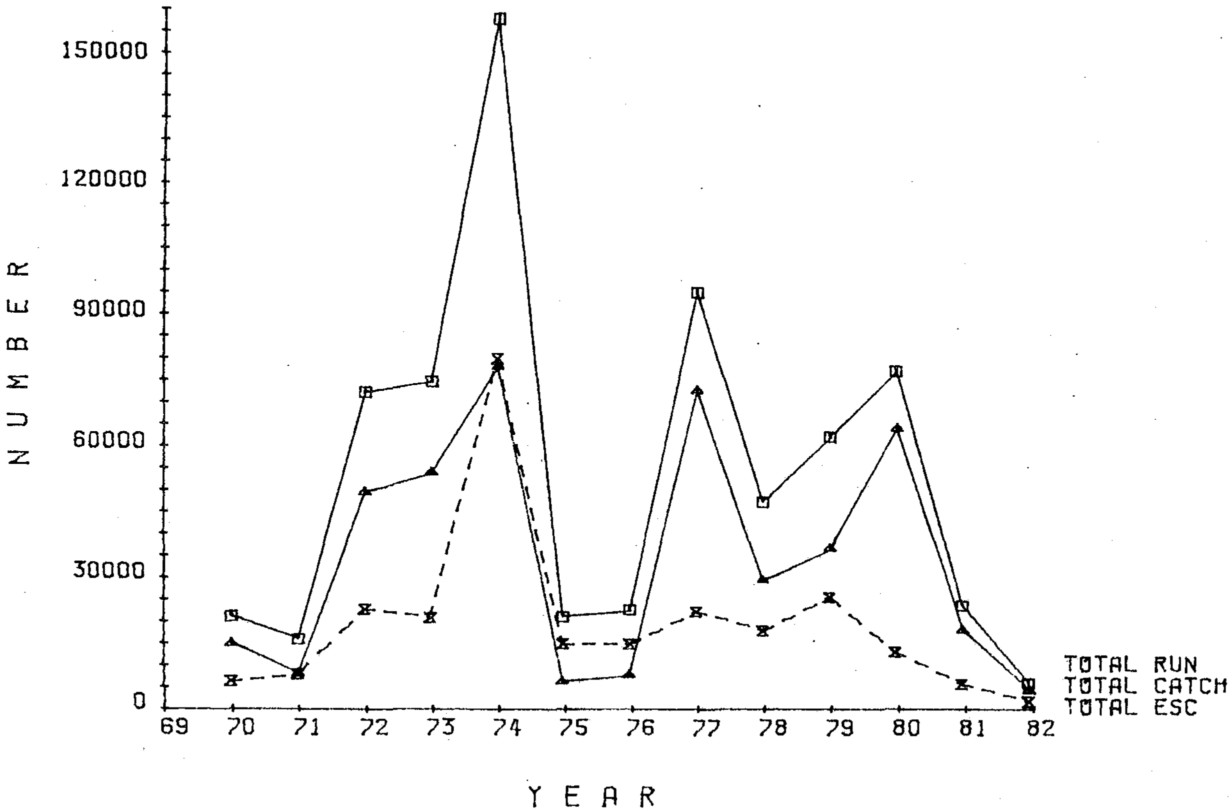
Stock assessment and escapement estimation are very difficult due to the presence of glacial silt. Hence short exploratory fisheries must often be conducted to determine stock size on an in-season basis. Timing of escapements from the terminal fishery for this stock group is characterized by a fairly rapid increase in escapement levels up to a peak in early July, followed by a slow decline over the next 4-5 weeks.

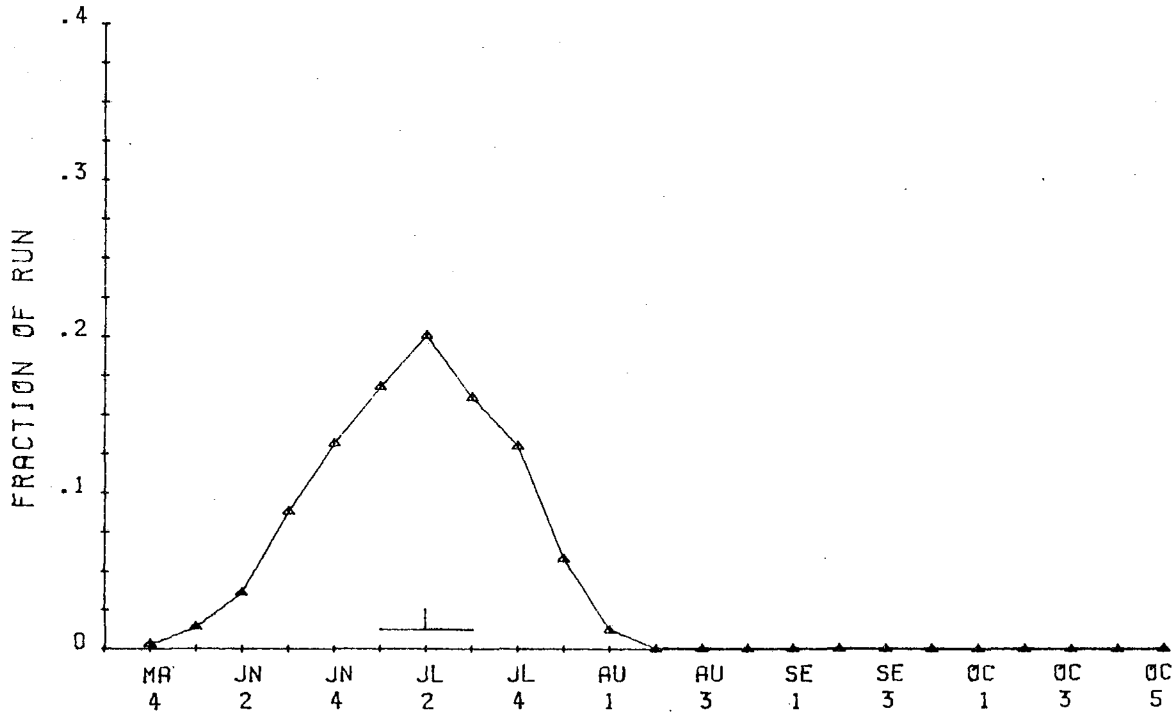
STOCK: AREA 3 OBSERVATORY INLET

YEAR	TOTAL RUN	TOTAL CATCH	TOTAL ESCAPE	HARVEST RATE	%CATCH NATIVE	%CATCH A1 TRL	%CATCH A1 NET	%CATCH AR 3XY	%CATCH AR 3Z	%CATCH AREA 4	%CATCH NOYES	%CATCH C.FOX
1970	21410	15110	6300	70.56	1.03	0.00	0.00	9.91	70.69	6.73	0.30	11.34
1971	16108	8108	8000	50.34	0.43	0.00	0.00	15.57	53.15	10.72	0.00	20.13
1972	72961	49961	23000	68.48	0.31	0.00	0.00	18.73	54.85	11.10	0.22	14.78
1973	75430	54430	21000	72.16	0.45	0.00	0.00	7.27	67.23	12.56	0.49	11.99
1974	159364	78864	80500	49.49	0.57	0.00	0.00	18.31	55.26	16.52	0.54	8.81
1975	21231	6231	15000	29.35	3.41	0.00	0.00	22.43	26.91	25.70	2.63	18.92
1976	22859	7859	15000	34.38	2.62	0.00	0.00	22.53	23.59	8.88	4.05	38.33
1977	95813	73312	22500	76.52	0.59	0.00	0.00	17.45	62.91	10.88	0.86	7.29
1978	47641	29641	18000	62.22	0.60	0.00	0.00	26.37	35.47	18.01	1.47	18.08
1979	62757	36957	25800	58.89	2.60	0.00	0.00	24.46	23.85	26.59	7.24	15.26
1980	77806	64706	13100	83.16	0.38	0.00	0.00	21.90	48.21	16.25	2.80	10.46
1981	23833	18133	5700	76.08	1.06	0.00	0.00	30.05	22.62	32.58	2.26	11.42
1982	5888	4188	1700	71.15	1.29	0.00	0.00	20.96	16.98	41.23	4.18	15.37

Over the time frame of the analysis, both catches and escapements of the Observatory Inlet chum stock grouping peaked in 1974. In recent years, the catch and escapement have declined to very low levels, while harvest rates have remained high. Apart from within Observatory Inlet itself, there is no active management of chum salmon in Area 3, so the low harvest rates on this and the Portland/Nass stock which occurred in 1971, 1975 and 1976 are actually due to low pink salmon runs. The timing of Area 3 Observatory Inlet chum is such that it is not caught in the Area 1 fisheries, although Noyes Island contributes a small component of the catch. The Area 3XY, Area 3Z, Area 4 and Cape Fox fisheries have the major impact on the stock, with Area 3Z dominating in most years. The native food fishery catch component ranges from 0-3%. The entering run timing for Observatory Inlet chum has a 50% mark in the second week of July, but occurs over a considerable period of time, from late May to early August.

Area 3 Observatory Inlet Chum





Area 3 Portland/Nass Chum

This stock group includes all chum stocks produced in streams draining into Portland Canal, Portland Inlet and the Nass River. Major stocks include the Khutzeymateen and Kwinamass in Portland Inlet as well as the Nass mainstem. Portland Canal streams are minor producers, with the bulk of the catch in this area probably due to U.S. stocks. There is little or no opportunity for terminal area management since the major mixed stock fishery for local pink and sockeye stocks takes place in the terminal or near-terminal areas of these chum stocks.

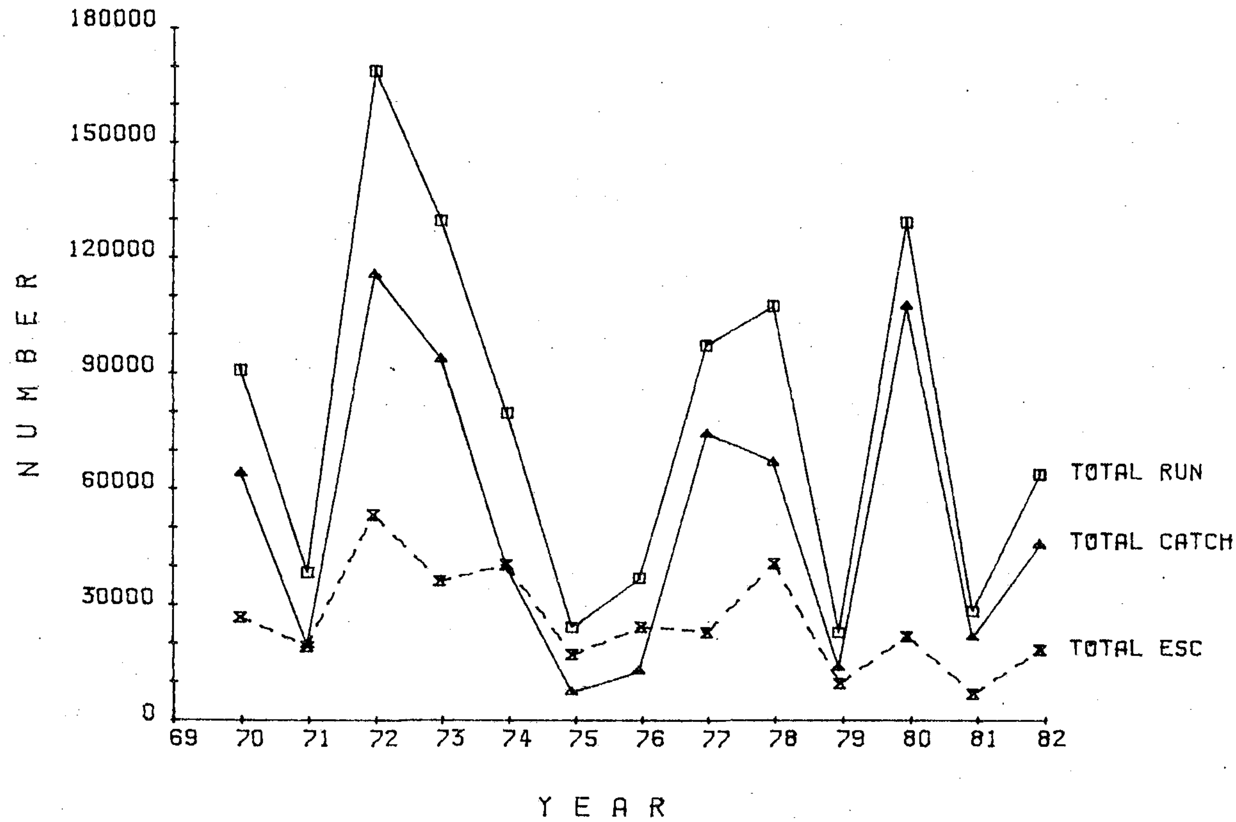
Escapement estimates are generally made by aerial surveys and are of relatively high quality due to the clarity of most of these streams.

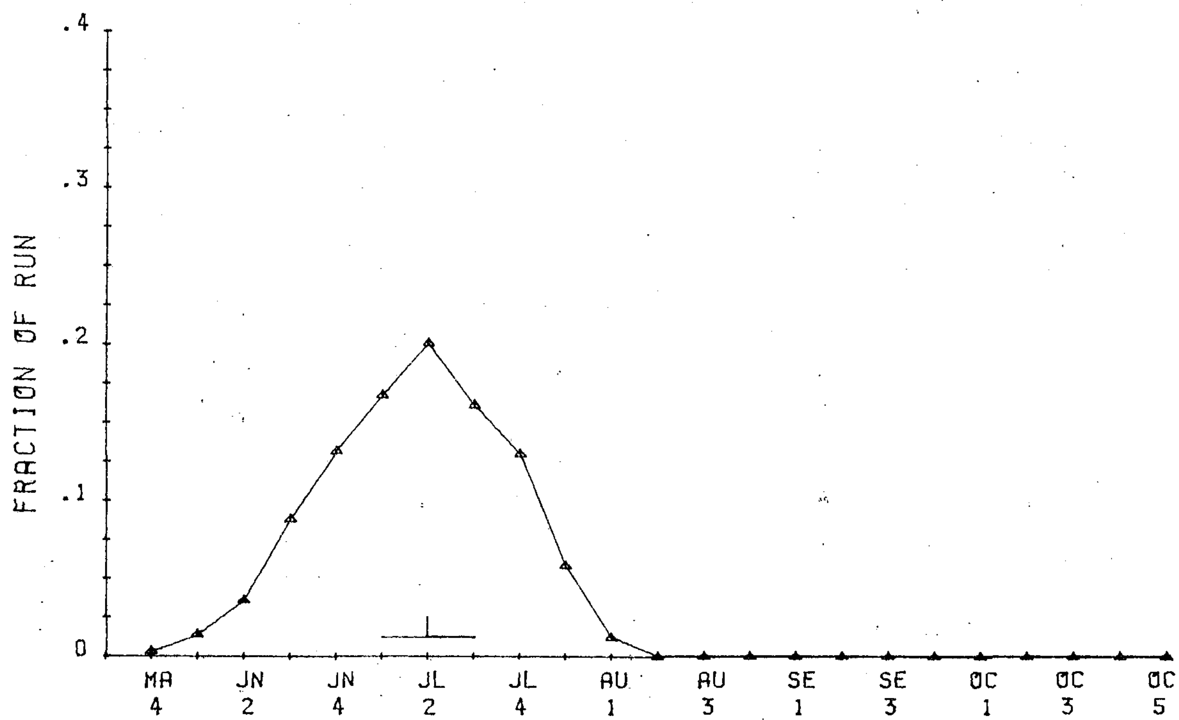
STOCK: AREA 3 PORTLAND/NASS

YEAR	TOTAL RUN	TOTAL CATCH	TOTAL ESCAPE	HARVEST RATE	%CATCH NATIVE	%CATCH A1 TRL	%CATCH A1 NET	%CATCH AR 3XY	%CATCH AR 3Z	%CATCH AREA 4	%CATCH NOYES	%CATCH C.FOX
1970	90608	63931	26677	70.56	1.03	0.00	0.00	9.90	70.70	6.73	0.30	11.34
1971	38309	19287	19022	50.35	0.43	0.00	0.00	15.57	53.14	10.75	0.00	20.11
1972	168516	115388	53128	68.47	0.31	0.00	0.00	18.73	54.86	11.10	0.22	14.78
1973	129391	93364	36027	72.16	0.45	0.00	0.00	7.27	67.23	12.55	0.49	12.00
1974	79597	39390	40207	49.49	0.57	0.00	0.00	18.31	55.26	16.52	0.54	8.81
1975	24062	7062	17000	29.35	3.41	0.00	0.00	22.43	26.91	25.71	2.63	18.92
1976	36797	12651	24146	34.38	2.62	0.00	0.00	22.53	23.58	8.88	4.05	38.33
1977	96977	74202	22775	76.51	0.59	0.00	0.00	17.46	62.91	10.88	0.86	7.29
1978	107111	66640	40471	62.22	0.60	0.00	0.00	26.37	35.48	18.01	1.47	18.08
1979	22586	13302	9284	58.89	2.60	0.00	0.00	24.46	23.83	26.62	7.24	15.25
1980	128789	107095	21694	83.16	0.38	0.00	0.00	21.91	48.22	16.23	2.80	10.46
1981	28122	21394	6728	76.08	1.06	0.00	0.00	30.07	22.64	32.52	2.26	11.43
1982	63622	45345	18277	71.27	1.28	0.00	0.00	20.81	16.92	41.55	4.15	15.29

The Portland/Nass stock group shows considerable fluctuations in its total run size, but this variability is absorbed primarily in the catch levels, leaving spawning escapements that exhibit a clear declining trend over time. Since the escapement timing and the migration routes assumed for the Portland/Nass stock are identical to those of the Observatory Inlet stock, the resulting harvest rates, catch distribution between fisheries and entering run timing are as for the Observatory Inlet chum stock. In particular, harvest rates have been between 50-80% in all but the poor years of 1975 and 1976, and have remained high in recent years in spite of declining escapement levels. These harvest rates are driven by the abundance of pink and sockeye stocks in the terminal Area 3 fisheries, where chum stocks are passively managed outside of Observatory Inlet.

Area 3 Portland/Nass Chum





Area 4 Chum

Within the Skeena River drainage, which contains the major portion of this stock group, the current and potential production of chum salmon is probably less than that of any other salmon species. Chum salmon are present in significant numbers only as far upstream as the Kispiox River, with the bulk of the Area 4 production coming from tributary and mainstem areas below the Lakelse River. Major producers include the Ecstall and Gitnadoix Rivers and mainstem side-channels. As a group these stocks are not specifically managed for, and the catch is always incidental to targetted fisheries on other stocks.

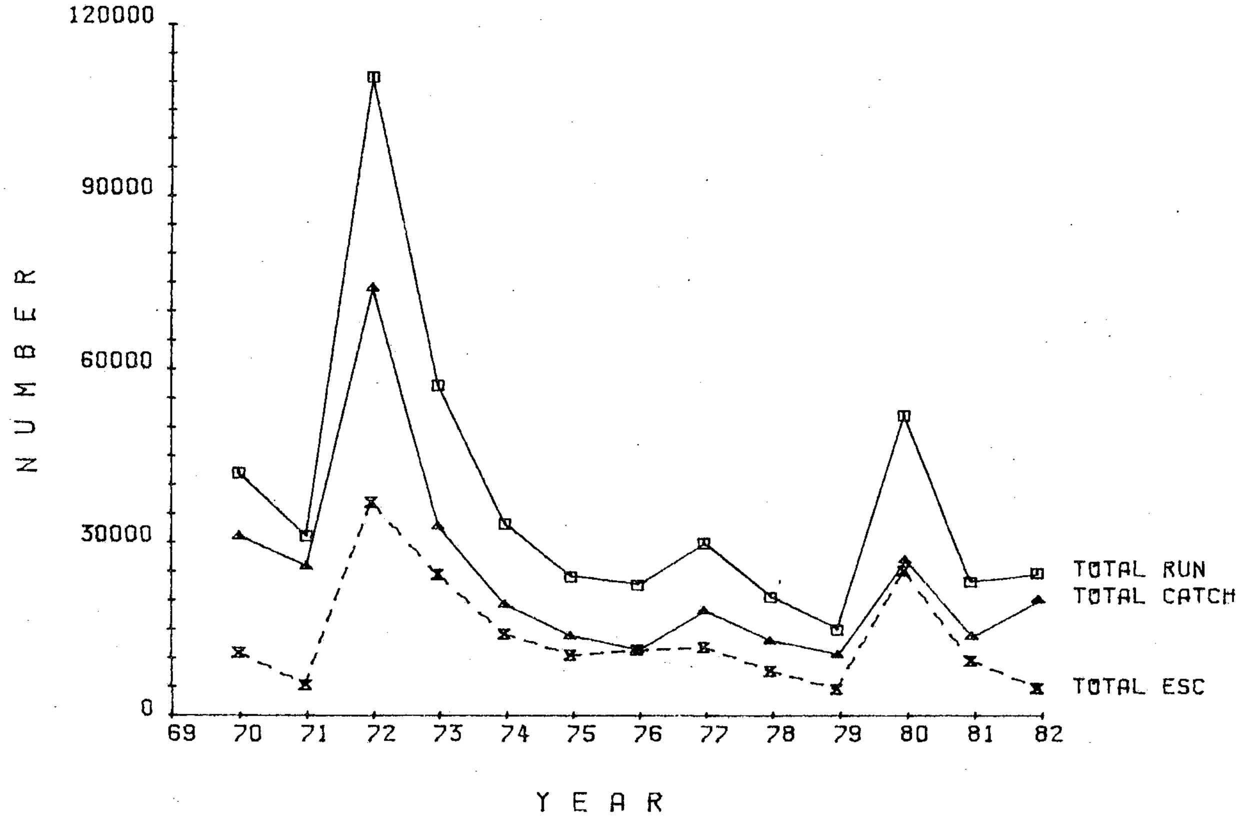
Escapement estimates are of fair to good quality, depending on the amount of aerial surveying time available. Escapement timing, based on fishery officer estimates and average test fishery timing results, shows a considerable spread over time, with a peak in mid-August.

STOCK: AREA 4

YEAR	TOTAL RUN	TOTAL CATCH	TOTAL ESCAPE	HARVEST RATE	%CATCH NATIVE	%CATCH A1 TRL	%CATCH A1 NET	%CATCH AR 3XY	%CATCH AREA 4	%CATCH AREA 5	%CATCH NOYES	%CATCH C.FOX
1970	41825	30960	10865	74.02	1.15	0.03	0.28	30.20	21.75	39.94	0.30	6.35
1971	30967	25717	5250	83.05	4.26	0.12	0.55	29.44	45.76	14.62	1.57	3.68
1972	110586	73786	36800	66.72	0.75	0.03	0.19	35.38	35.77	17.10	1.64	9.13
1973	56986	32636	24350	57.27	1.60	0.06	1.65	17.71	53.23	8.85	3.35	13.56
1974	33060	19060	14000	57.65	2.62	0.06	1.78	38.53	26.49	7.48	2.24	20.79
1975	23985	13605	10380	56.72	4.78	0.08	1.70	20.76	43.45	12.89	0.82	15.52
1976	22583	11257	11326	49.85	4.00	0.04	0.00	15.61	35.51	18.88	2.93	23.03
1977	29806	18006	11800	60.41	5.55	0.14	0.29	30.40	32.76	20.56	1.51	8.79
1978	20419	12789	7630	62.63	0.78	0.69	0.01	15.19	38.10	30.61	1.58	13.04
1979	14832	10376	4456	69.96	3.28	0.69	0.00	18.77	47.65	13.86	7.18	8.57
1980	51810	26800	25010	51.73	4.29	2.59	1.47	31.82	7.80	34.01	4.35	13.67
1981	23012	13648	9364	59.31	3.21	0.81	3.92	10.93	39.47	9.23	10.21	22.22
1982	24618	19984	4634	81.18	1.50	0.42	0.00	26.23	22.15	11.63	12.04	26.03

Over the period 1970-1982, the Area 4 chum results are dominated by a large run in 1972. Thereafter the total run, catch and escapement show a smooth downward trend, with the run size reaching an equilibrium around 25000 and the escapement apparently continuing to decline (apart from a strong year in 1980). Harvest rates have ranged from 50% (in 1976) to 83% (in 1971), but have tended to lie between 55-70% in most years. This moderately stable harvest rate pattern arises from the passive management of Area 4 chum, and the orientation of harvesting decisions towards sockeye and pink stocks, particularly the stable Pinkut/Fulton Babine stocks. The Area 4 terminal fishery, together with Area 3XY and Area 5, play the major roles in the catch distribution of Area 4 chum salmon, although Cape Fox and Noyes Island are also important. The local native food fishery catches between 1-6% of the total harvest of this stock. The entering run of Area 4 chum reaches the study area over a lengthy period of time, between early July and mid-September. The 50% median timing occurs in the first week of August, with a spread of 3 weeks being possible due to year-to-year timing variations.

Area 4 Chum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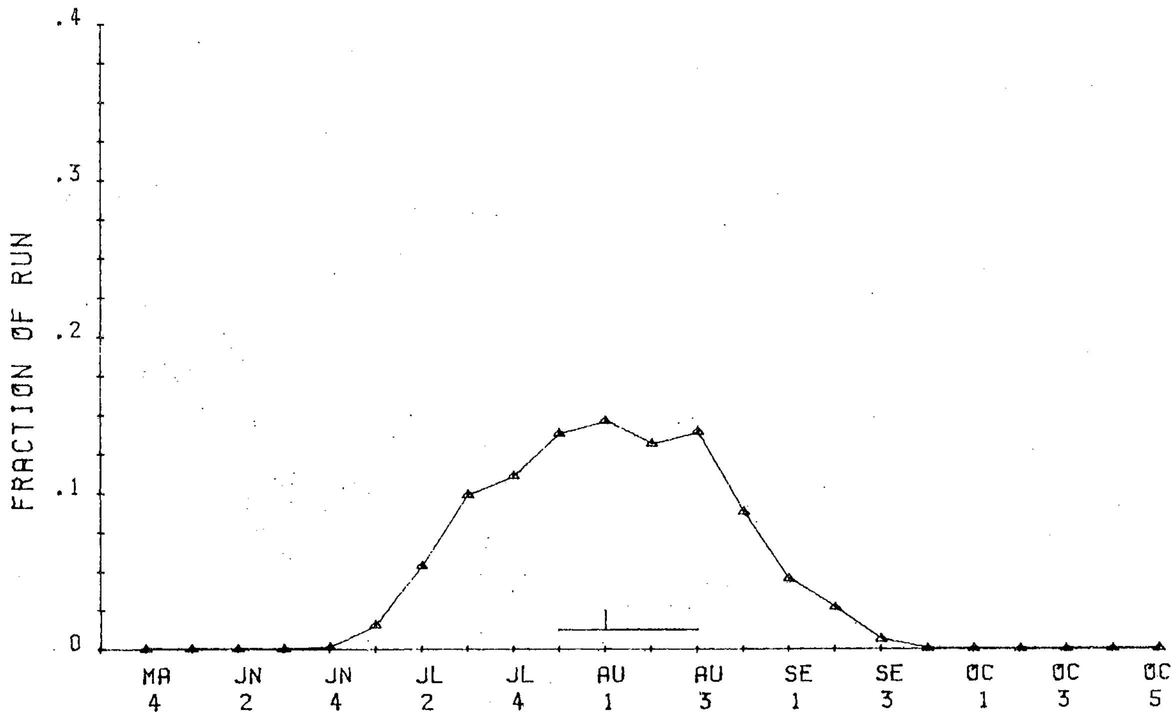
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Area 5 Chum

Major chum stocks in Area 5 include Bonilla Arm Creeks (Kingkown Inlet) and Wilson Inlet Creek. Portions of Statistical Area 5 are frequently fished for passing stocks of Skeena sockeye and pink as well as passing Central Coast and northerly migrating chum. Local chum stocks, despite their later escapement timing, undoubtedly are also harvested during these fisheries. Combined with the apparent low productivity of these stocks, terminal area management, which can be practiced after the closure of interception fisheries, is not always productive.

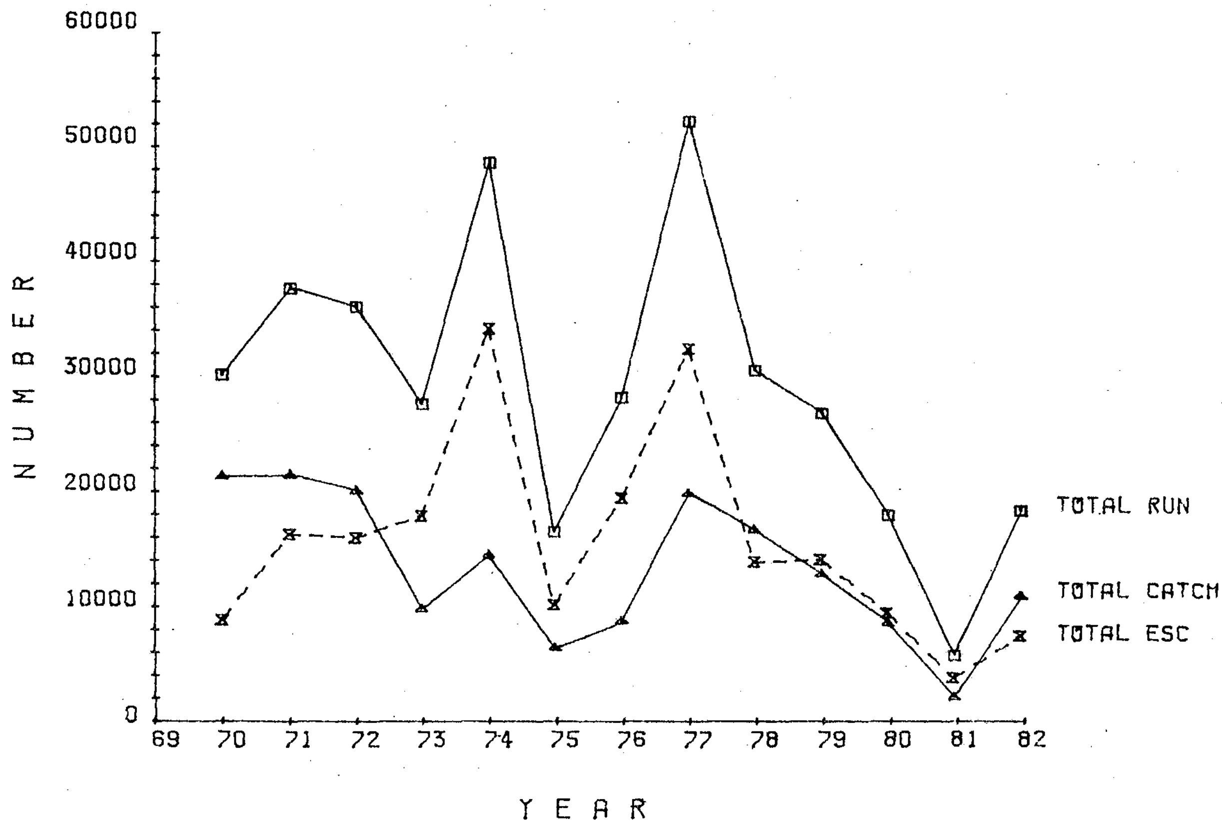
Escapements are usually monitored by vessel-based foot surveys, which produce a highly variable quality of estimates due to variations in visibility, water levels and the timing of surveys.

STOCK: AREA 5

YEAR	TOTAL RUN	TOTAL CATCH	TOTAL ESCAPE	HARVEST RATE	%CATCH NATIVE	%CATCH A1 TRL	%CATCH A1 NET	%CATCH AREA 4	%CATCH AREA 5	%CATCH NOYES
1970	29926	21159	8767	70.70	0.87	0.05	0.21	3.98	94.47	0.42
1971	37411	21286	16125	56.90	0.99	0.18	0.37	21.65	74.43	2.38
1972	35800	19927	15873	55.66	5.02	0.02	0.22	11.86	81.78	1.10
1973	27418	9673	17745	35.28	2.23	0.08	1.82	34.91	58.43	2.53
1974	48239	14339	33900	29.72	1.15	0.12	2.69	23.78	69.64	2.62
1975	16354	6304	10050	38.54	1.59	0.12	1.35	24.26	72.50	0.18
1976	27990	8664	19326	30.95	0.58	0.07	0.00	10.39	86.54	2.41
1977	51842	19675	32167	37.95	0.00	0.28	0.35	26.74	70.53	2.10
1978	30294	16517	13777	54.52	0.18	0.92	0.01	8.86	88.35	1.68
1979	26594	12646	13948	47.55	0.00	2.16	0.00	46.76	48.22	2.86
1980	17788	8434	9354	47.41	0.59	5.44	1.15	1.36	86.51	4.95
1981	5655	2005	3650	35.45	9.98	2.77	6.78	27.41	45.62	7.44
1982	18142	10769	7373	59.36	1.86	0.72	0.00	15.16	73.74	8.53

In broad terms, Area 5 chum escapements increased from 1970 to peaks in 1974 and 1977, then declined to low levels in 1981-1982. The total run size and the catch display clear decreases over time, although some improvement is evident in 1982 results. Area 5 chum are caught primarily in the Area 5 terminal fishery, although Area 4 catches can be proportionately large (reaching 47% of the catch in 1979). Correlations with Area 5 pink abundance and with sockeye and pink runs in Area 4 show that the distribution of chum catch is actually driven by these targetted species. Area 1, Noyes Island and the local Native food fishery play fairly small roles, although the native catch reached 10% in 1981 and the proportion of the catch harvested at Noyes Island has increased in recent years. Overall harvest rates on Area 5 chum have been typically within the range 30-60%, with no trend being apparent over time. Timing of the entering run is peaked in the first week of August, with little year to year variability.

Area 5 Chum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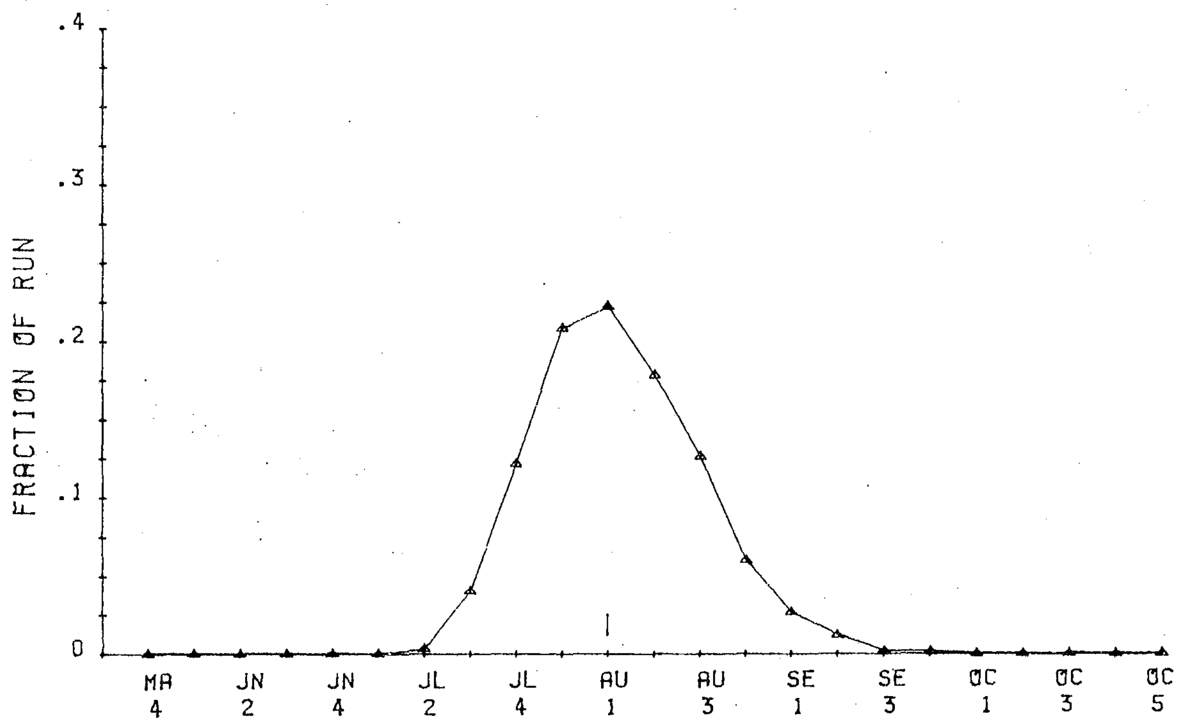
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Central Coast

The Central Coast region, incorporating statistical areas 6 through 10, lies on the western coast of British Columbia between 51° 15' and 53° 15' north latitude. Eight chum fisheries are identified within the region (Fig. 6). Of these, there is one in each of statistical areas 7, 9 and 10, two, the Gil and Laredo fisheries, in statistical area 6 and three, the Fisher-Fitzhugh, Dean and Bella Coola fisheries in statistical area 8. Two of the fisheries are known to intercept chum destined for statistical areas outside that in which the fisheries occur (Table 13). The Laredo fishery harvests a small proportion of the chum destined for statistical area 7 as well as those originating from the southern part of statistical area 6. The Area 7 fishery harvests chum originating from both statistical areas 7 and 8. Several changes have been made in recent years to reduce the impact of some of the intercepting fisheries. The changes include the gradual elimination of the July portion of the Laredo fishery and the curtailment of the outer Milbanke Sound portion of the Area 7 fishery.

Chum salmon are caught in the Gil, Laredo, Area 7 and Fisher-Fitzhugh fisheries with both gillnets and seine nets (Table 12). In all four fisheries the greater part of the catch is taken in seining operations. The Area 9 fishery also employed both gillnets and seine nets between 1970 and 1978 although the gillnet catch always exceeded that taken by seines. Since 1978 only gillnets have been employed in the Area 9 fishery. Gillnets are the only gear type used in the Bella Coola, Dean and Area 10 fisheries.

Thirteen major chum stocks were identified in Central Coast (Fig. 6). Seven of the major stocks were disaggregated into sub-stocks based on timing, routing and management considerations (Table 13). The largest stocks are locatedin the northern portion of Central Coast, particularly in statistical areas 7 and 8.

Generally, chum salmon begin entering Central Coast fisheries in early to mid July and peak in abundance in late July to late August (Table 12). During this period of shoreward migration chum salmon move rapidly, not spending more than a week in any one fishery. Following escapement from the terminal fisheries, chum salmon move directly into streams and rivers where spawning generally peaks between early August and early September (Table 14). While the general temporal pattern of movement of Central Coast chum salmon is as described above, little is known about the degree of annual variation in run timing for most stocks.

The run size of all Central Coast chum stocks combined was very eratic between 1970 and 1975 (Fig. 7). During this period the run size ranged from a high of 2.75 million pieces in 1973 to a low of 600,000 pieces in 1975. Following 1975 there was a gradual but discontinuous increase in run size through 1982. Estimates of total Central Coast chum catch and escapement exhibited a similar pattern, both peaking in 1973 at approximately 1.65 and 1.10 million pieces respectively.

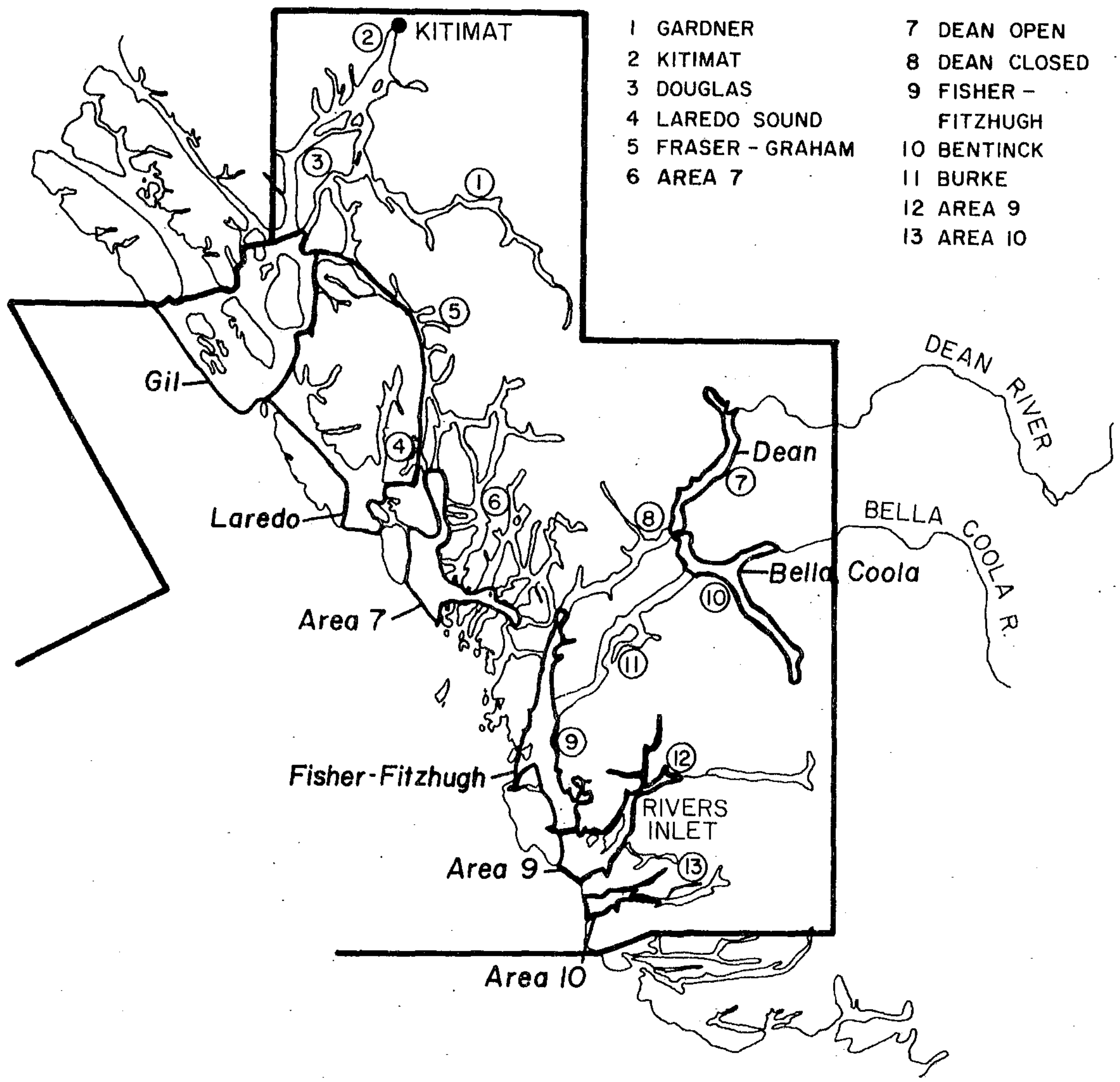

Fig. 6. The major chum salmon stocks and chum salmon fisheries (boldface type) on the Central Coast.

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Table 12. Gear types employed in Central Coast chum fisheries and catch timing in the fisheries.

Fishery	Gear Types(s)	Catch Timing: Start	Catch Timing: Peak	Catch Timing: End
Gil	gillnet/seine net	early to mid July	late July to early August	early September
Laredo	gillnet/seine net	early to mid July	late July to early August	early September
Area 7	gillnet/seine net	early to mid July	mid to late August	early to mid September
Fisher-Fitzhugh	gillnet/seine net	early to mid July	late July to early August	mid September
Dean	gillnet	early to mid July	late July to early August	early to mid September
Bella Coola	gillnet	late June to early July	late July to early August	late August to early October
Area 9	gillnet/seine net	mid June to mid July	late July to mid August	early September to early October
Area 10	gillnet	early to mid July	early August to early September	early September to early October

Table 13. Migration routes through fisheries for Central Coast chum stocks and sub stocks.

Stock Name	Sub-stock Name	Routing by Fishery	Proportion of Stock Utilizing each Route
Gardner	Gil/Gardner	Gil	0.6
	Laredo/Gardner	Laredo->Gil	0.4
Kitimat	Gil/Kitimat	Gil	0.6
	Laredo/Kitimat	Laredo->Gil	0.4
Douglas	Gil/Douglas	Gil	0.6
	Laredo/Douglas	Laredo->Gil	0.4
Laredo Sound	none	Laredo	1.0
Fraser-Graham	none	Laredo	1.0
Area 7	Area 7	Area 7	0.9
	Laredo/Area 7	Laredo-> Area 7	0.1
Dean Open	Fisher-Fitzhugh/Dean Open	Fisher-Fitzhugh-> Dean	0.34
	Area7/Dean Open	Area 7-> Dean	0.33
	Bella Coola/Dean Open	Fisher-Fitzhugh->Bella Coola->Dean	0.33
Dean Closed	Fisher-Fitzhugh/Dean Closed	Fisher-Fitzhugh	0.8
	Area 7/Dean Closed	Area 7	0.2
Fisher-Fitzhugh	none	Fisher-Fitzhugh	1.0
Bentinck	Burke/Bentinck	Fisher-Fitzhugh->Bella Coola	0.4
	Dean Closed/Bentinck	Fisher-Fitzhugh->Bella Coola	0.2
	Area 7/Bentinck	Area 7->Bella Coola	0.4
Burke	none	Fisher-Fitzhugh	1.0
Area 9	none	Area 9	1.0
Area 10	none	Area 10	1.0

Table 14. Spawning escapement timing for Central Coast chum stocks.

Stock	Escapement Timing		
	Start	Peak	End
Gardner	mid July	early August	early September
Kitimat	mid July	mid August	early September
Douglas	mid July	mid August	early September
Laredo Sound	mid July	early August	early September
Fraser-Graham	mid July	early August	early September
Area 7	early August	early September	early October
Dean Open	early July	early August	early September
Dean Closed	mid July	mid August	mid September
Fisher-Fitzhugh	early August	early September	early October
Bentinck	early August	early September	early October
Burke	early August	early September	early October
Area 9	late July	late August	late September
Area 10	early August	early September	early October

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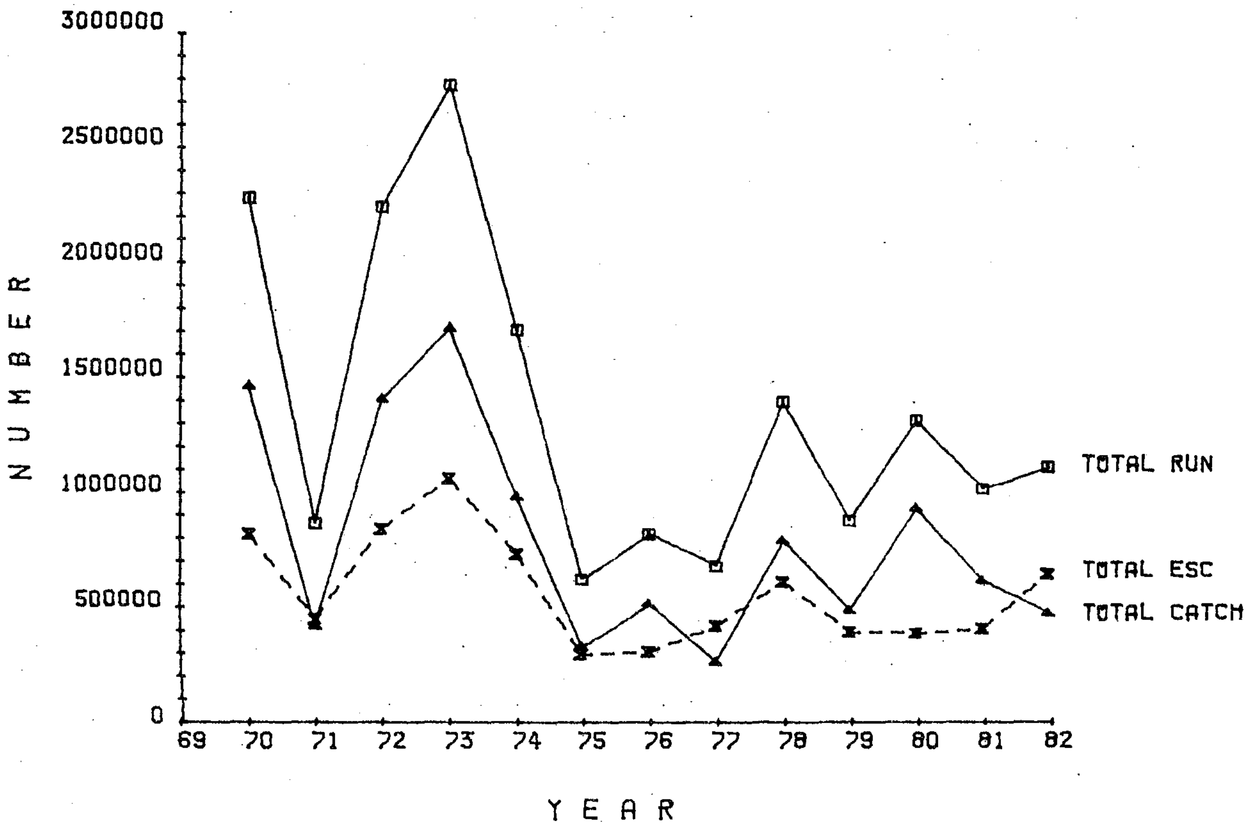


Fig. 7. Catch, escapement and total run size for Central Coast chum salmon stocks, 1970 to 1982.

Gardner Chum

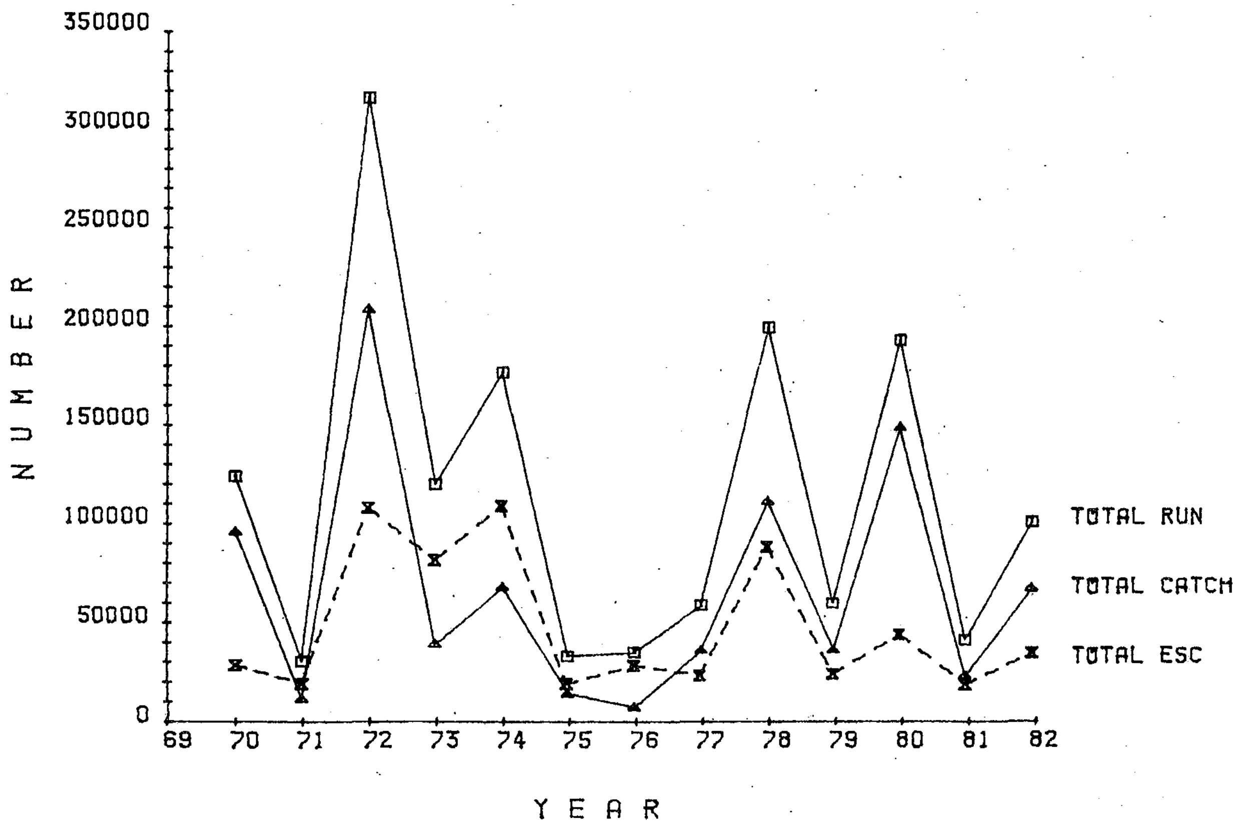
The Gardner chum stock aggregation originates from 10 tributaries of Gardner Canal located in the northern portion of statistical area 6. The strength of the Gardner Chum stock is very dependent on the Kemano River component which accounts for approximately 90% of total annual escapement of the stock. The Gardner chum stock is intercepted in three fisheries, two located in statistical area 6 and one in statistical area 7. The Gil fishery, located in the vicinity of Gil Island in the northern portion of statistical area 6 and the Laredo fishery, situated in the vicinity of Laredo channel at the southern end of statistical area 6, accounted for approximately 73 and 8% respectively of the total catch of the stock between 1970 and 1982. The remaining 19% of the total catch was taken in the Area 7 fishery.

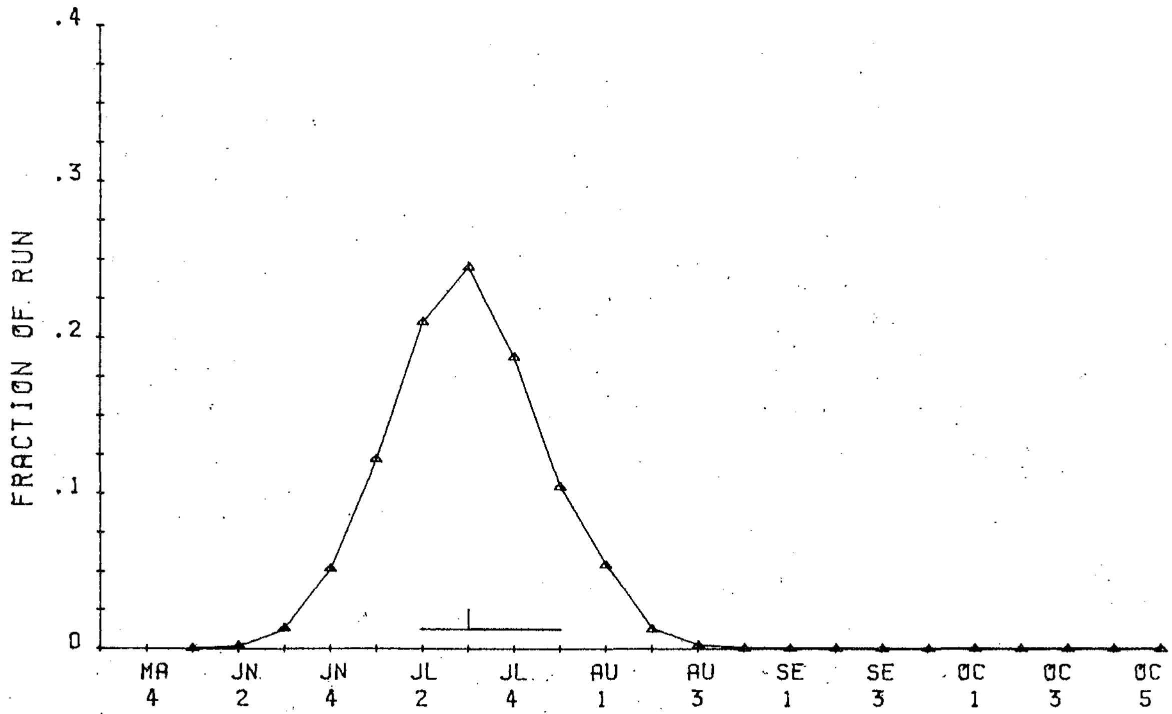
STOCK : GARDNER

YEAR	TOTAL RUN	TOTAL CATCH	TOTAL ESCAPE	HARVEST RATE	%CATCH GIL	%CATCH LAREDO	%CATCH AREA 7
1970	123794	95469	28325	77.12	79.12	4.63	16.24
1971	30262	11287	18975	37.30	93.65	4.92	1.43
1972	315354	207754	107599	65.88	91.33	3.82	4.85
1973	119717	38643	81074	32.28	94.80	2.57	2.63
1974	176046	67546	108500	38.37	66.85	4.98	28.17
1975	32588	13588	19000	41.70	73.72	2.74	23.55
1976	34936	6786	28150	19.42	51.43	5.76	42.80
1977	58595	35620	22975	60.79	49.78	23.01	27.22
1978	198629	110785	87845	55.77	76.45	14.14	9.41
1979	59475	35675	23800	59.98	80.09	2.97	16.94
1980	192042	148212	43830	77.18	63.02	10.83	26.15
1981	40708	22373	18335	54.96	69.92	7.63	22.45
1982	100847	66571	34275	66.01	67.34	8.10	24.56

The mean run size of the Gardner chum stock represented approximately 8.4% of the mean run size of all Central Coast chum stocks combined between 1970 and 1982. No trends were observed in estimates of run size, catch or escapement, however, all varied by approximately an order of magnitude between 1970 and 1982. The largest run size of Gardner chum occurred in 1972 at over 300,000 pieces. Total run sizes of less than 50,000 pieces were recorded in 1971, 1975, 1976 and 1981. The mean harvest rate on the stock between 1970 and 1982 was approximately 53.0%. The average median for entering run timing at the Gil and Area 7 fisheries occurs during the third week of July.

Gardner Chum





Kitimat Chum

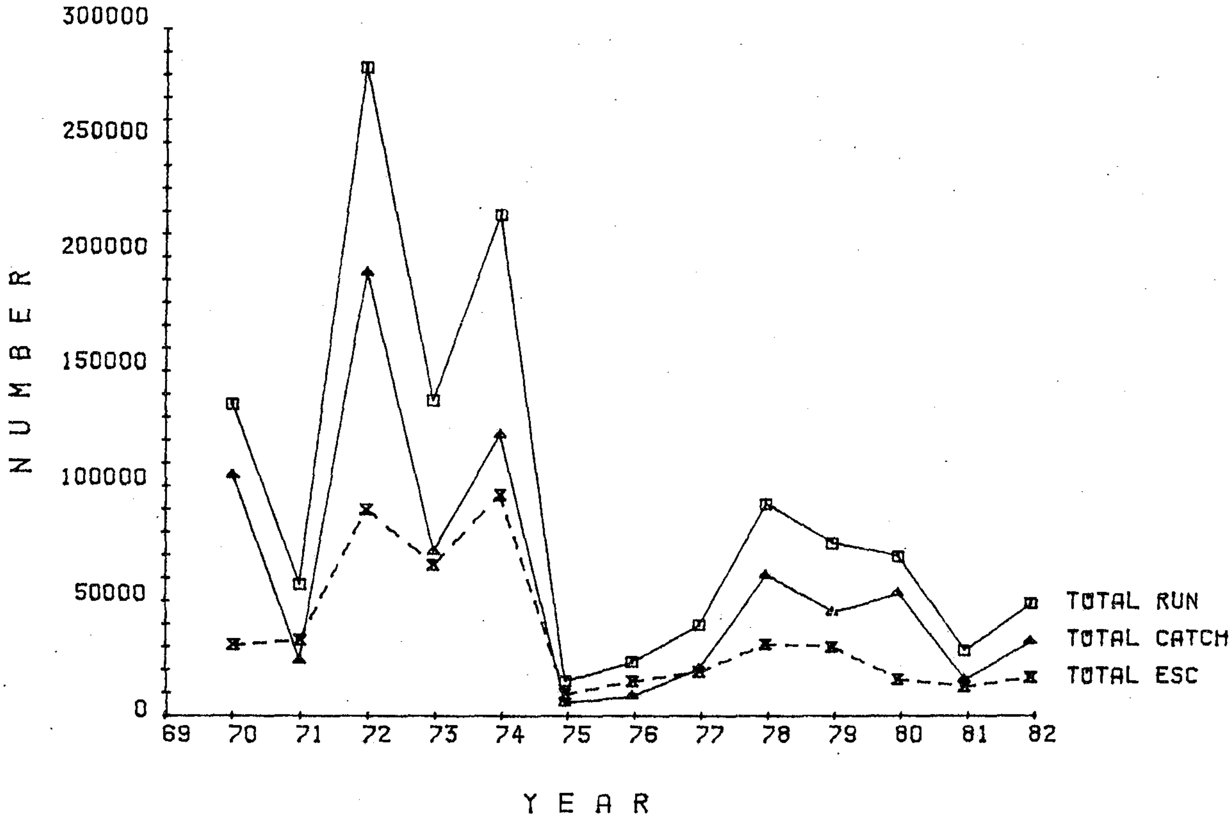
The Kitimat chum stock aggregation originates from 14 tributaries of Kitimat and Kildala Arm, both located in the northern portion of statistical area 6. Two of these tributaries, Kitimat and Kildala River, account for approximately 80% of the total annual escapement of the stock. The Kitimat chum stock is intercepted in three fisheries, two located in statistical area 6 and one in statistical area 7. The Gil fishery, located in the vicinity of Gil Island in the northern portion of statistical area 6 and the Laredo fishery, situated in the vicinity of Laredo Channel in the southern portion of statistical area 6, accounted for approximately 73 and 8% respectively of the total catch of the stock between 1970 and 1982. The remaining 19% of the catch was taken in the Area 7 fishery.

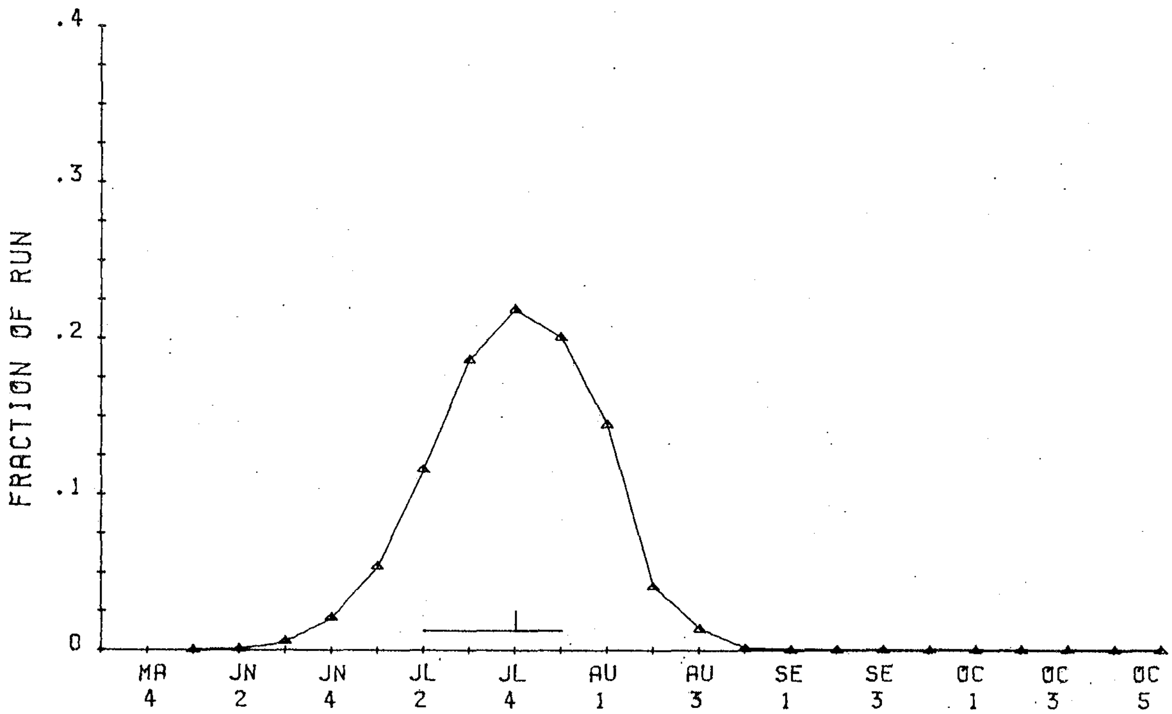
STOCK : KITIMAT

YEAR	TOTAL RUN	TOTAL CATCH	TOTAL ESCAPE	HARVEST RATE	%CATCH GIL	%CATCH LAREDO	%CATCH AREA 7
1970	134719	103895	30825	77.12	79.12	4.63	16.24
1971	56691	23840	32850	42.05	91.38	1.02	7.61
1972	281161	191861	89300	68.24	82.01	2.73	15.26
1973	136245	70995	65250	52.11	82.65	4.87	12.48
1974	216892	121452	95440	56.00	39.60	6.28	54.12
1975	14813	5463	9350	36.88	62.48	1.25	36.28
1976	23216	8406	14810	36.21	52.18	2.69	45.13
1977	39276	20161	19115	51.33	52.83	13.54	33.63
1978	91429	60659	30770	66.35	59.57	13.50	26.93
1979	74319	44579	29740	59.98	80.09	2.97	16.94
1980	68614	52954	15660	77.18	63.02	10.83	26.15
1981	27975	15375	12600	54.96	69.92	7.63	22.45
1982	48577	32067	16510	66.01	67.34	8.10	24.56

The mean annual run size of the Kitimat stock represented approximately 6.9% of the mean annual run size of all Central Coast chum stocks between 1970 and 1982. Similar to the adjacent Gardner and Douglas chum stocks, the Kitimat stock exhibited an abrupt decline in run size, catch and escapement between 1974 and 1975. However, Kitimat chum, unlike the Gardner and Douglas stocks, did not recover in the post 1975 time period. The largest run size and catch of Kitimat chum occurred in 1972 at approximately 280,000 and 190,000 pieces respectively. The largest escapement at almost 100,000 pieces was recorded in 1974. The smallest run size at approximately 150,000 pieces occurred in 1975. The mean harvest rate on the Kitimat chum stock between 1970 and 1982 was approximately 57.0%. The average median for entering run timing at the Gil and Area 7 fisheries occurs during the fourth week of July.

Kitimat Chum





Douglas Chum

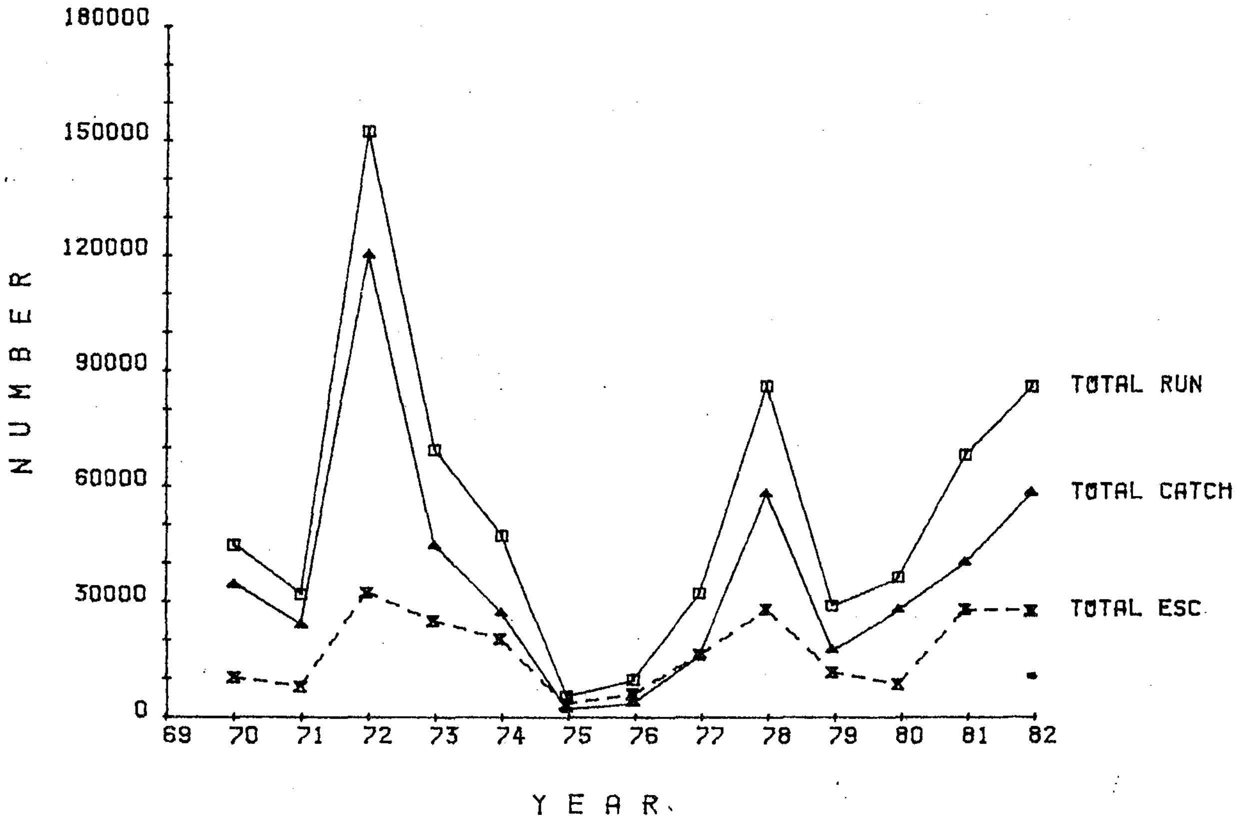
The Douglas chum stock aggregation originates from 17 streams and rivers in the vicinity of Douglas, Ursula and Devistation Channel, located in the northern portion of statistical area 6. Three of these systems, Foch, Gilttoyees and Verney Passage Creek, account for over 95% of the total annual escapement of the Douglas chum stock. The stock is intercepted in three fisheries, two located in statistical area 6 and one in statistical area 7. The Gil fishery, located in the vicinity of Gil Island in the northern portion of statistical area 6 and the Laredo fishery, situated in the vicinity of Laredo Channel in the southern portion of statistical area 6, accounted for approximately 67 and 6% respectively of the total catch of the stock between 1970 and 1982. The remaining 27% of the catch was taken in the area 7 fishery.

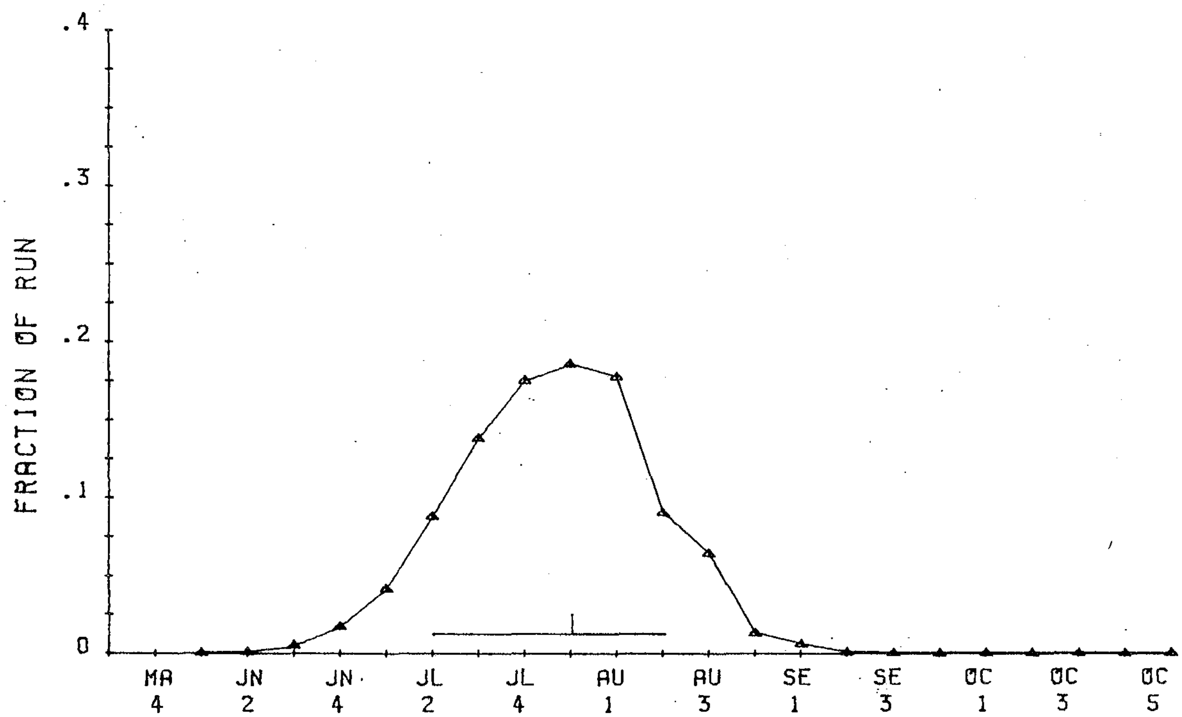
STOCK : DOUGLAS

YEAR	TOTAL RUN	TOTAL CATCH	TOTAL ESCAPE	HARVEST RATE	%CATCH GIL	%CATCH LAREDO	%CATCH AREA 7
1970	44676	34376	10300	76.95	78.92	4.68	16.41
1971	31715	23915	7800	75.41	89.05	1.09	9.86
1972	152089	119914	32175	78.84	74.35	3.02	22.63
1973	69272	44422	24850	64.13	71.21	3.32	25.47
1974	47069	26939	20130	57.23	42.57	5.97	51.46
1975	5309	1972	3337	37.15	62.91	1.23	35.86
1976	9608	3708	5900	38.59	56.81	2.43	40.75
1977	32071	15966	16105	49.78	49.81	14.41	35.78
1978	85925	57960	27965	67.45	61.54	12.84	25.62
1979	28839	17299	11540	59.98	80.09	2.97	16.94
1980	36179	27734	8445	76.66	61.93	11.15	26.92
1981	68084	40130	27955	58.94	74.43	6.49	19.08
1982	85654	58109	27545	67.84	69.93	7.46	22.61

The mean annual run size of the Douglas stock represented approximately 4.0% of the mean annual run size of all Central Coast chum stocks combined between 1970 and 1982. Catch, escapement and run size of the Douglas chum stock declined through the early and mid 1970's as did the adjacent Gardner and Kitimat stocks. However, after 1975 the stock began to rebuild with run size increasing discontinuously through 1982. The largest run size, catch and escapement for the Douglas chum stock occurred in 1972 at approximately 150,000, 120,000 and 30,000 pieces respectively. The smallest run size, only slightly more than 5,000 pieces, was recorded in 1975. The mean harvest rate on the Douglas chum stock between 1970 and 1982 was approximately 67.0%. The average median for entering run timing at the Gil and Area 7 fisheries occurs during the fifth week of July.

Douglas Chum





Laredo Sound Chum

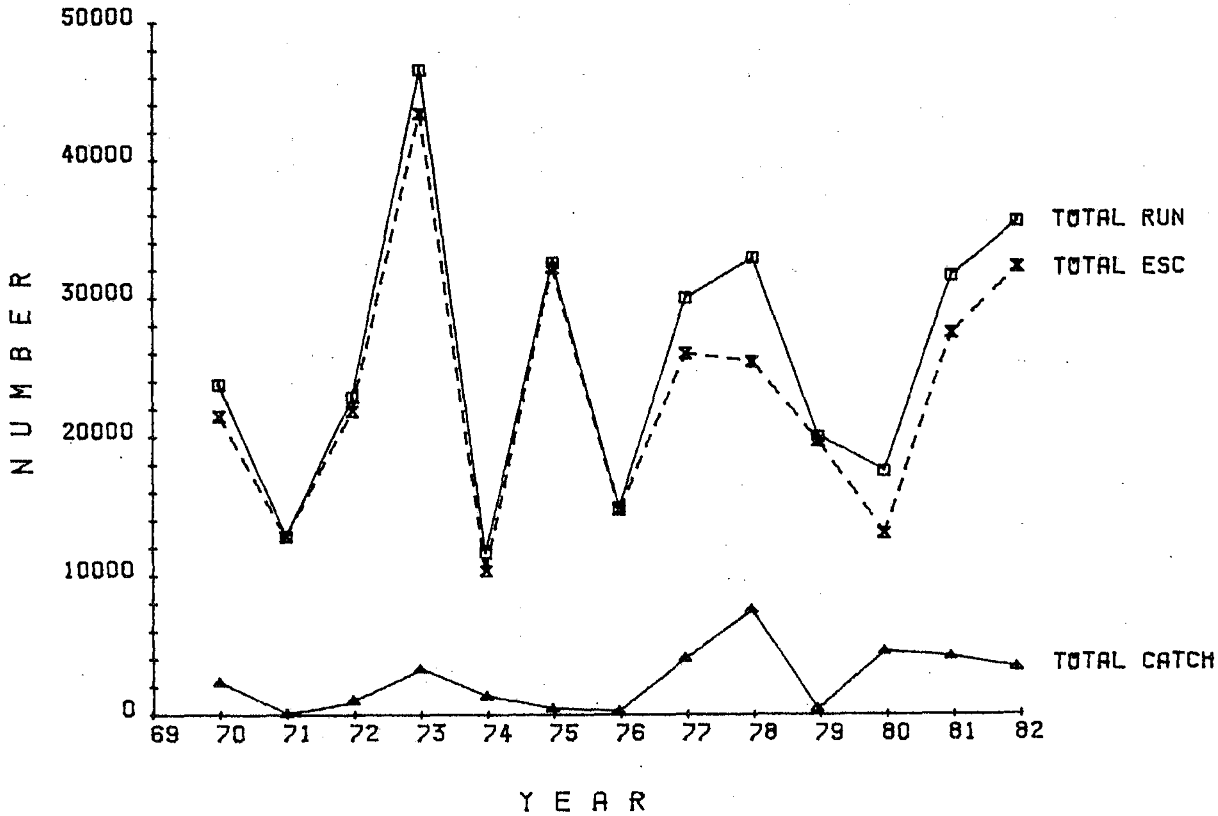
The Laredo Sound chum stock aggregation originates from 20 streams and rivers in the vicinity of Laredo Sound and Laredo Inlet, located in the southern portion of statistical area 6. Four of these systems, Price, Nias, Arnoup and Tyler Creek account for approximately 80% of the total annual escapement of the Laredo Sound chum stock. The stock is intercepted in the Laredo fishery.

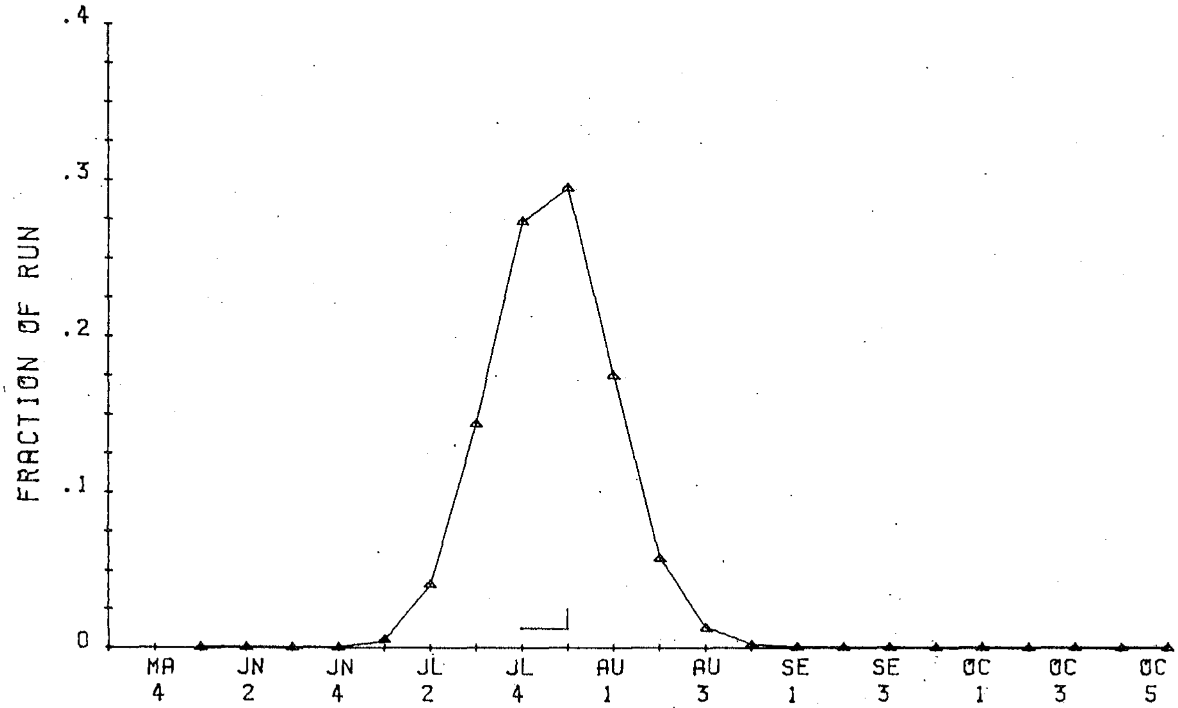
STOCK : LAREDO SOUND

YEAR	TOTAL RUN	TOTAL CATCH	TOTAL ESCAPE	HARVEST RATE	%CATCH LAREDO
1970	23771	2271	21500	9.55	100.00
1971	12845	70	12775	0.55	100.00
1972	22869	994	21875	4.35	100.00
1973	46652	3251	43400	6.97	100.00
1974	11604	1279	10325	11.02	100.00
1975	32564	395	32169	1.21	100.00
1976	14896	196	14700	1.32	100.00
1977	29970	3998	25972	13.34	100.00
1978	32911	7506	25405	22.81	100.00
1979	20028	353	19675	1.76	100.00
1980	17519	4499	13020	25.68	100.00
1981	31558	4113	27445	13.03	100.00
1982	35479	3299	32180	9.30	100.00

The Laredo Sound chum stock is small. The mean annual run size of the stock represented approximately 2.0% of the mean annual run size of all Central Coast chum stocks combined between 1970 and 1982. No trend was observed in the estimates of catch, escapement or run size although all three exhibited a high degree of inter-year variability. The largest estimated run size and escapement were observed in 1973 at approximately 47,000 and 43,000 pieces respectively. The lowest estimates were recorded in the following year. Catch from the Laredo Sound chum stock varied from less than 500 pieces in 1971, 1975, 1976 and 1979 to 7,500 pieces in 1978. The mean harvest rate on the stock between 1970 and 1982 was approximately 9.0%. The average median for entering run timing at the Laredo fishery occurs during the fifth week of July.

Laredo Sound Chum





Fraser-Graham Chum

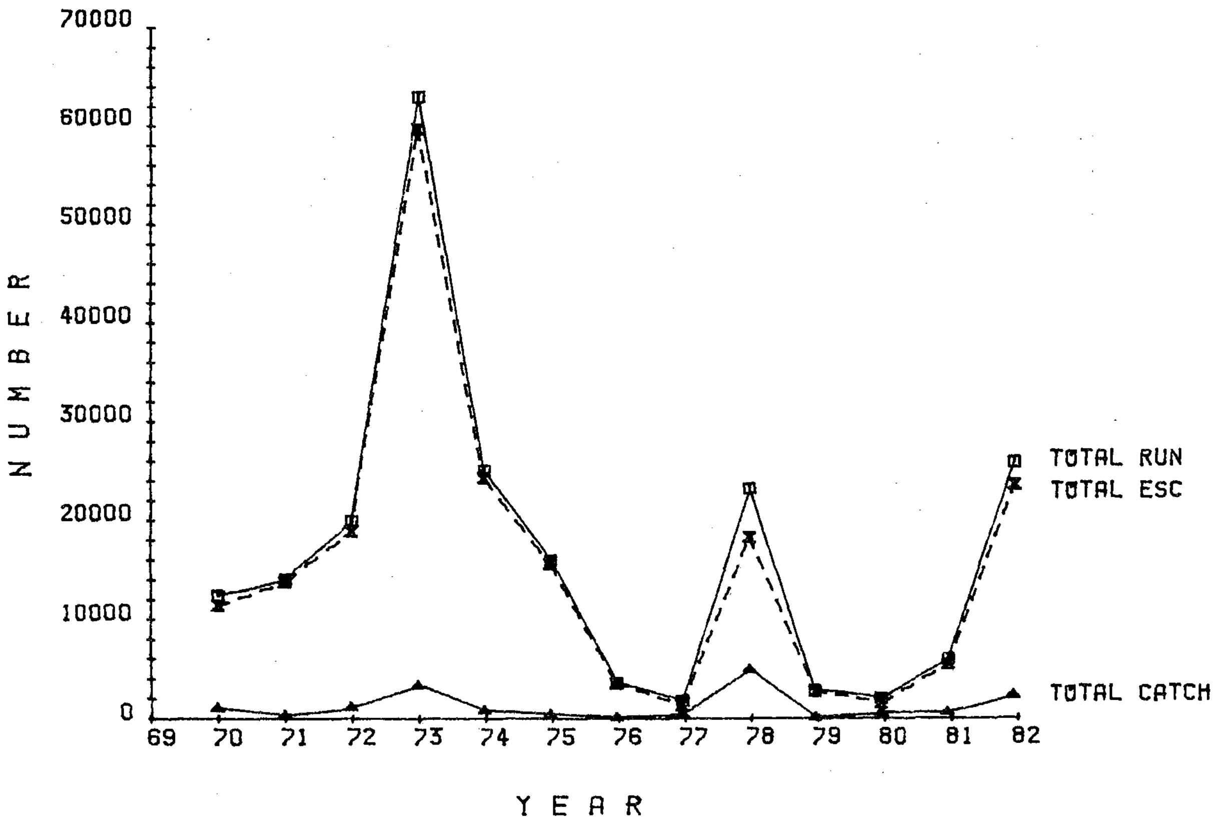
The Fraser-Graham chum stock aggregation originates from 15 streams and rivers in the vicinity of Tolmie Channel, Fraser Reach and Graham Reach, all located in the central and southern portions of statistical area 6. Two of these systems, Green Inlet Creek and Khutze River account for approximately 70% of the total annual escapement of the Fraser-Graham chum stock. The stock is intercepted in the Laredo fishery.

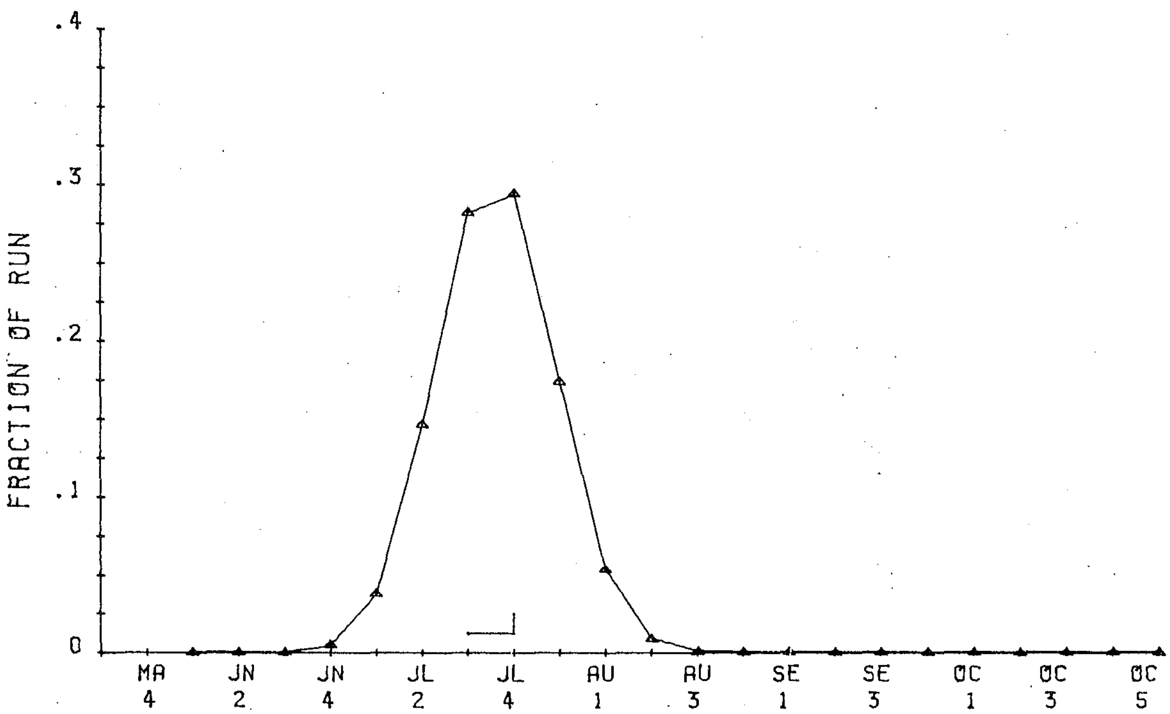
STOCK : FRASER-GRAHAM

YEAR	TOTAL RUN	TOTAL CATCH	TOTAL ESCAPE	HARVEST RATE	%CATCH LAREDO
1970	12431	1031	11400	8.30	100.00
1971	14040	315	13725	2.24	100.00
1972	19908	1083	18825	5.44	100.00
1973	62820	3320	59500	5.28	100.00
1974	24975	775	24200	3.10	100.00
1975	15910	430	15480	2.70	100.00
1976	3552	82	3470	2.31	100.00
1977	1689	421	1268	24.91	100.00
1978	23125	4890	18235	21.15	100.00
1979	2766	106	2660	3.82	100.00
1980	1989	512	1477	25.75	100.00
1981	5932	542	5390	9.13	100.00
1982	25770	2242	23528	8.70	100.00

The Fraser-Graham chum stock is small. The mean annual run size of the stock represented approximately 1.0% of the mean annual run size of all Central Coast chum stocks combined between 1970 and 1982. Catch of chum from the Fraser-Graham stock was also small. In five of the 13 years less than 500 pieces were taken. The largest catch, 4,890 pieces, was taken in 1978. Estimates of escapement and total run size varied by more than an order of magnitude but exhibited no consistent trend. The largest escapement and run size were recorded in 1973 at approximately 60,000 and 63,000 pieces respectively. Total run size was less than 6,000 pieces in five of the seven years between 1977 and 1982. The mean harvest rate on the Fraser-Graham chum stock was approximately 9%. The average median for entering run timing at the Laredo fishery occurs during the fourth week of July.

Fraser-Graham Chum





Area 7 Chum

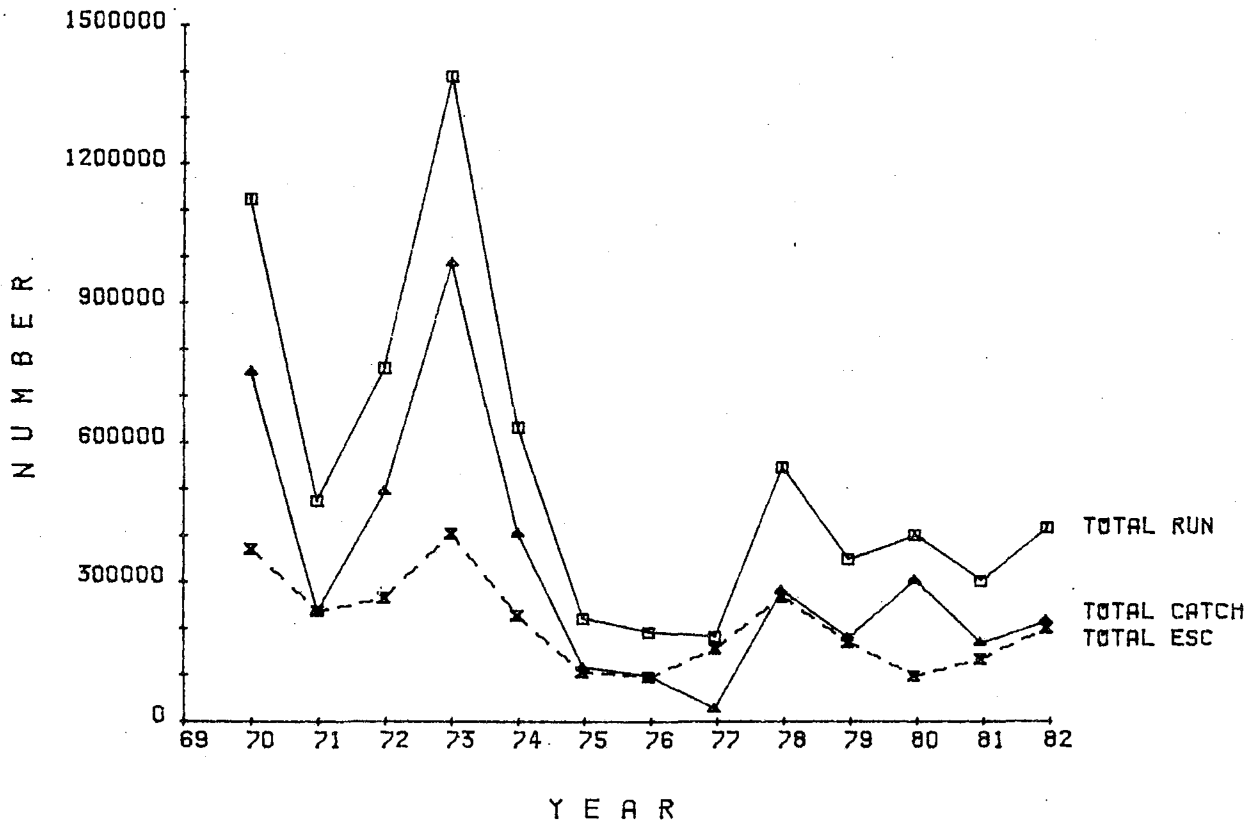
The Area 7 chum stock aggregation originates from 60 streams and rivers in statistical area 7. The stock is dominated by six systems, Kwakusdis and Mussel River and Kainet, Neekas, Clatse and Roscoe Creek, which together account for approximately two thirds of the total escapement of the Area 7 chum stock. The Area 7 chum stock is intercepted in the Area 7 and Laredo fisheries. In most years over 90% of the catch are taken in the Area 7 fishery.

STOCK : AREA 7

YEAR	TOTAL RUN	TOTAL CATCH	TOTAL ESCAPE	HARVEST RATE	%CATCH LAREDO	%CATCH AREA 7
1970	1128238	755588	372650	66.97	5.74	94.26
1971	475756	236983	238774	49.81	3.84	96.16
1972	764078	498078	266000	65.19	3.51	96.49
1973	1395670	990521	405149	70.97	2.35	97.65
1974	633607	405515	228092	64.00	11.65	88.35
1975	220582	114643	105939	51.97	0.59	99.41
1976	190857	95122	95734	49.84	2.14	97.86
1977	182046	26235	155811	14.41	4.93	95.07
1978	548619	280871	267748	51.20	5.96	94.04
1979	348837	179159	169678	51.36	0.33	99.67
1980	401706	304139	97568	75.71	6.58	93.42
1981	303430	168751	134679	55.61	9.22	90.78
1982	416849	216467	200382	51.93	8.23	91.77

The Area 7 chum stock is the largest chum stock on the Central Coast. The mean annual run size of the stock represented approximately 40% of the mean annual run size of all Central Coast chum stocks combined between 1970 and 1982. The total run size of the stock declined abruptly in the mid 1970's from an average of approximately 880,000 pieces between 1970 and 1974 to less than 330,000 pieces between 1975 and 1982. The catch of the stock exhibited a similar trend. The largest catch, approximately 1.4 million pieces, was recorded in 1973 and declined to less than 200,000 pieces in 1977. Escapement decreased discontinuously between 1970 and 1982 from a high of approximately 400,000 pieces in 1973 to less than 100,000 pieces in 1976. The mean harvest rate on the stock between 1970 and 1982 was approximately 55.0%. The average median for entering run timing at the Area 7 fishery was the third week of August.

Area 7 Chum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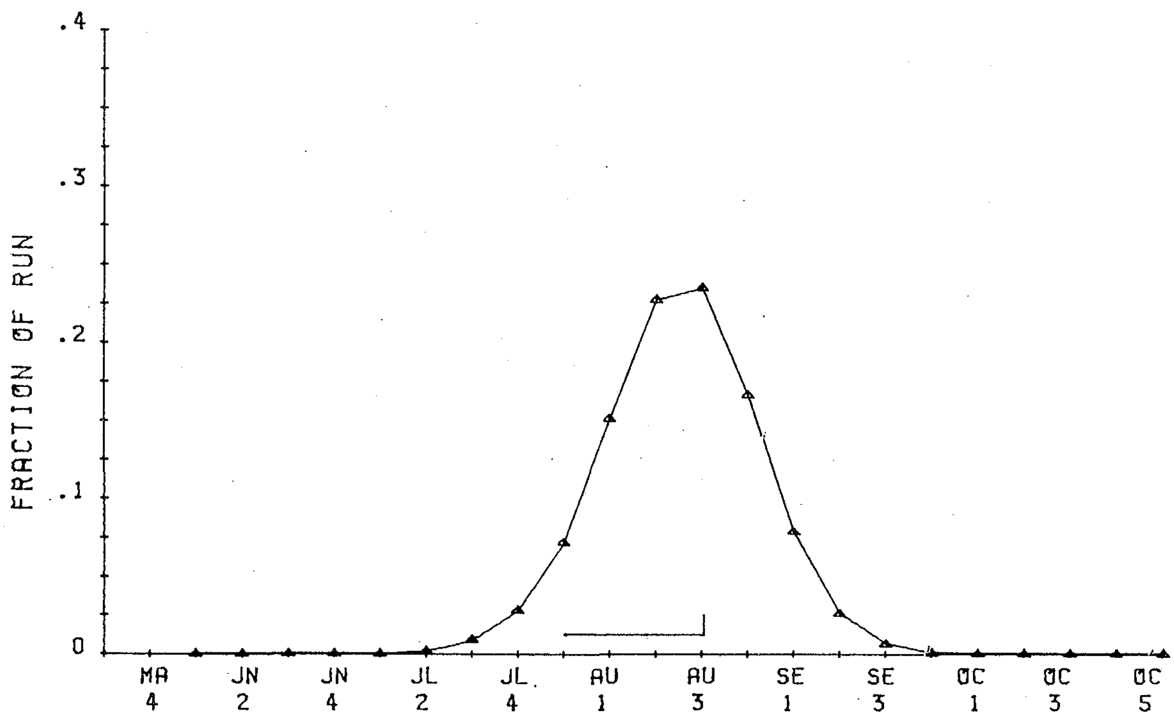
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Dean Open Chum

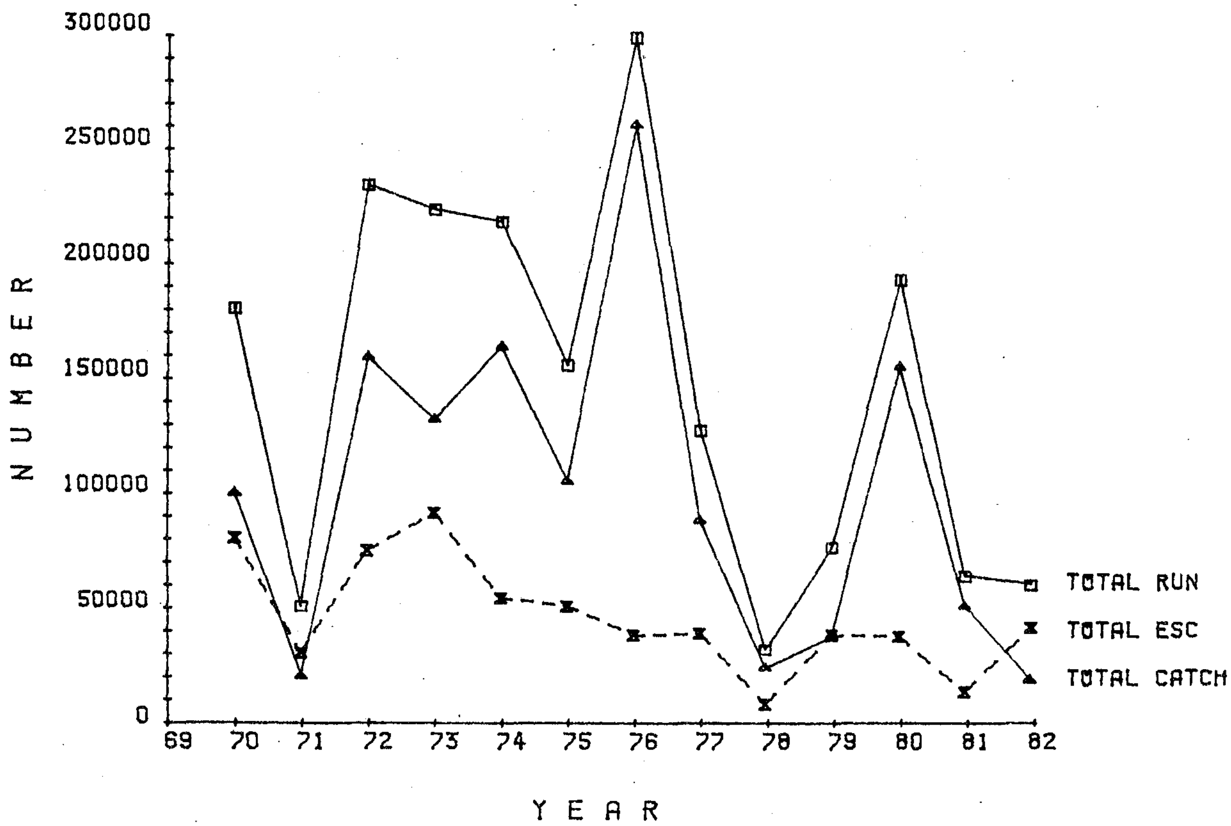
The Dean Open chum stock aggregation originates from five tributaries of Upper Dean Channel in the northern portion of statistical area 8. The Kimsquit River is the largest chum producing system in the group and annually accounts for approximately 90% of the total escapement of the stock. The Dean Open chum stock is intercepted in four fisheries, three located in statistical area 8 and one in statistical area 7. The Fisher-Fitzhugh fishery, located in Fisher Channel and Fitzhugh Sound, and the Dean fishery, located in the easternmost portion of Dean Channel, accounted for approximately 30 and 40% respectively of the total catch of the stock between 1970 and 1982. The remaining 30% of the catch was divided equally between the Bella Coola and Area 7 fisheries.

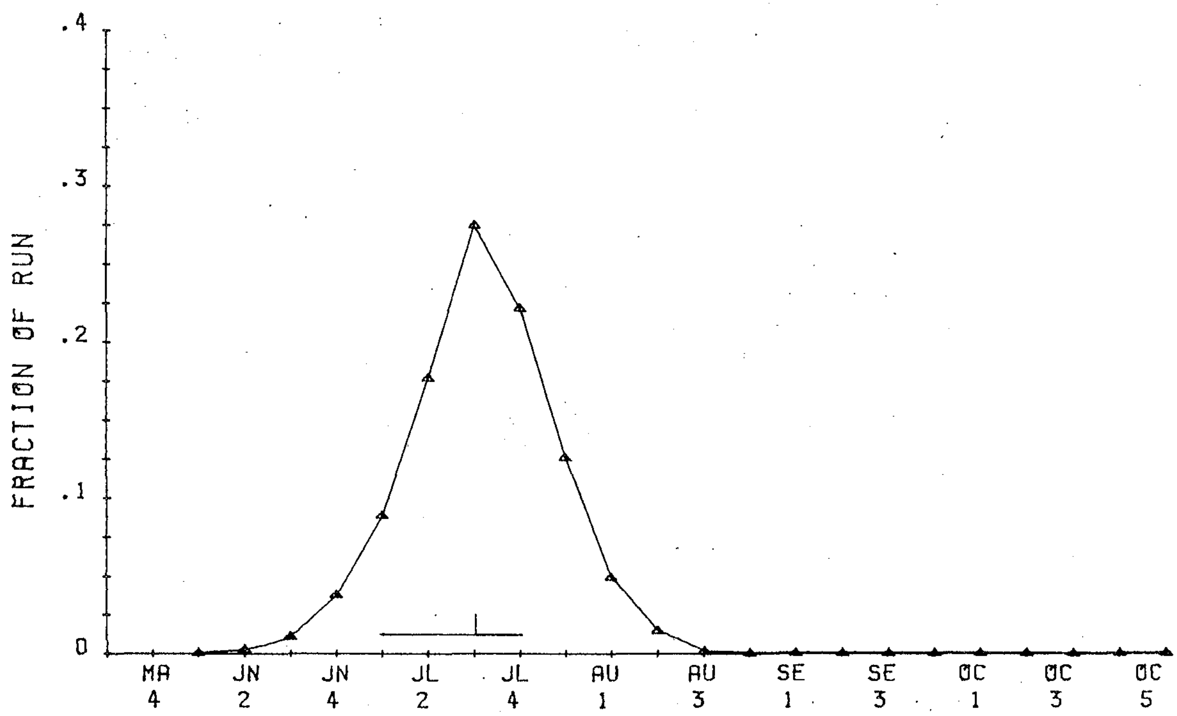
STOCK : DEAN OPEN

YEAR	TOTAL RUN	TOTAL CATCH	TOTAL ESCAPE	HARVEST RATE	%CATCH AREA 7	%CATCH FISHER-FITZ	%CATCH DEAN	%CATCH BELLA COOLA
1970	179243	99244	80000	55.37	17.51	46.65	28.01	7.83
1971	50219	20119	30100	40.06	5.19	20.57	63.24	10.99
1972	232493	158168	74325	68.03	11.67	26.17	52.75	9.41
1973	221978	131078	90900	59.05	19.16	4.63	72.64	3.57
1974	216617	162617	54000	75.07	18.76	33.34	31.38	16.52
1975	154595	104396	50200	67.53	19.83	32.70	45.63	1.85
1976	296619	258619	38000	87.19	7.34	38.82	35.44	18.39
1977	126251	87531	38720	69.33	23.27	16.15	44.60	15.99
1978	31541	23541	8000	74.64	6.39	30.40	3.77	59.44
1979	75810	37828	38000	49.90	17.07	23.21	51.55	8.17
1980	191255	153905	37350	80.47	13.51	51.93	28.40	6.16
1981	63366	50166	13200	79.17	9.10	44.24	32.71	13.95
1982	59521	18311	41210	30.76	32.10	21.66	31.98	14.25

The mean run size of the Dean Open chum stock represented approximately 11% of the mean run size of all Central Coast chum stocks combined between 1970 and 1982. Annual estimates of run size, catch and escapement varied by approximately an order of magnitude during this period. Superimposed on the large degree of variability was an apparent decrease in stock size which, based on escapement estimates, began in the early to mid 1970s. The largest run size and catch were recorded in 1976 at approximately 300,000 and 260,000 pieces respectively. Escapement peaked in 1973 at approximately 90,000 pieces. The mean harvest rate on the stock between 1970 and 1982 was 64.3%. The average median for entering run timing occurs during the third week of July.

Dean Open Chum





Dean Closed Chum

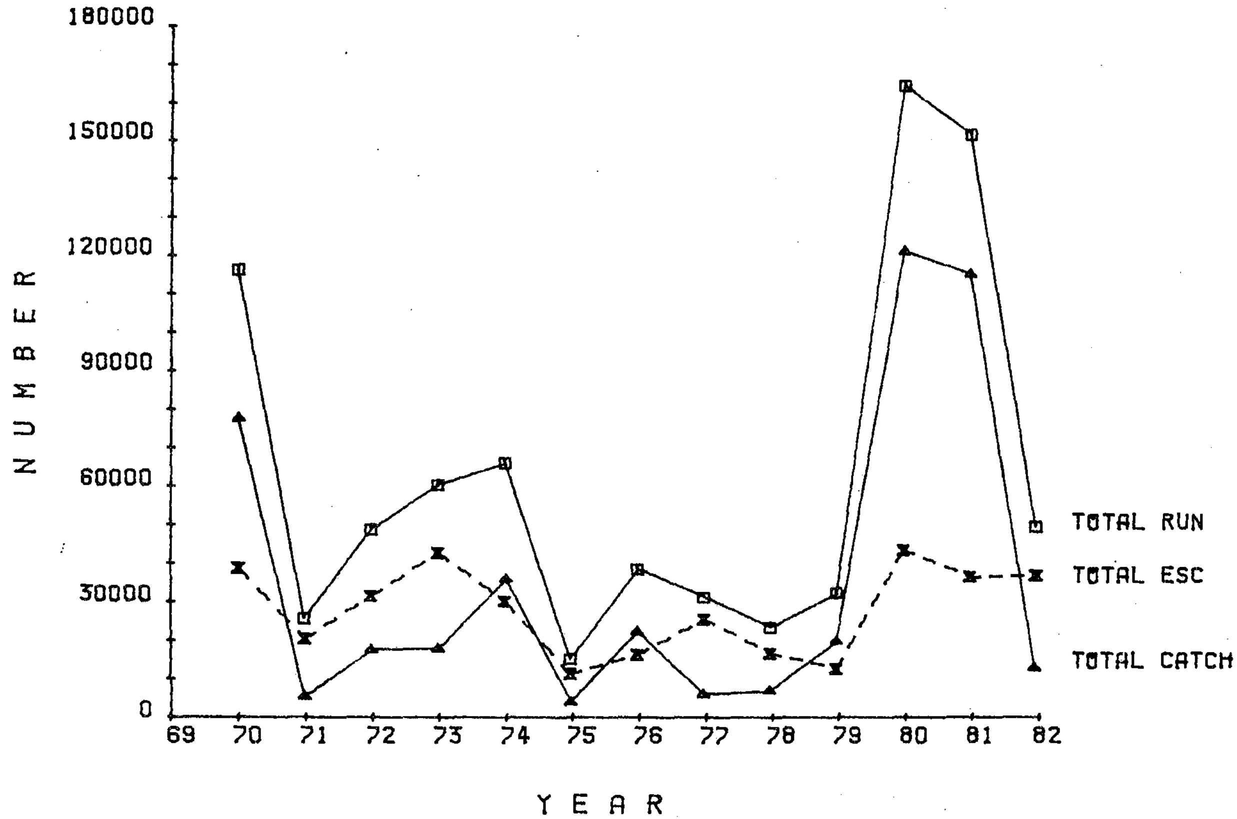
The Dean Closed chum stock aggregation originates from seven tributaries of the lower portion of Dean Channel in statistical area 8. The two largest chum producing systems in this group, Cascade River and Elcho Creek, account for approximately 60% of the total escapement of the stock. The Dean Closed chum stock is intercepted in two fisheries. The Fisher-Fitzhugh fishery, located in Fisher Channel and Fitzhugh Sound in statistical area 8, accounted for approximately 63% of the total catch of the stock between 1970 and 1982. The remaining 37% of the catch was taken in the Area 7 fishery.

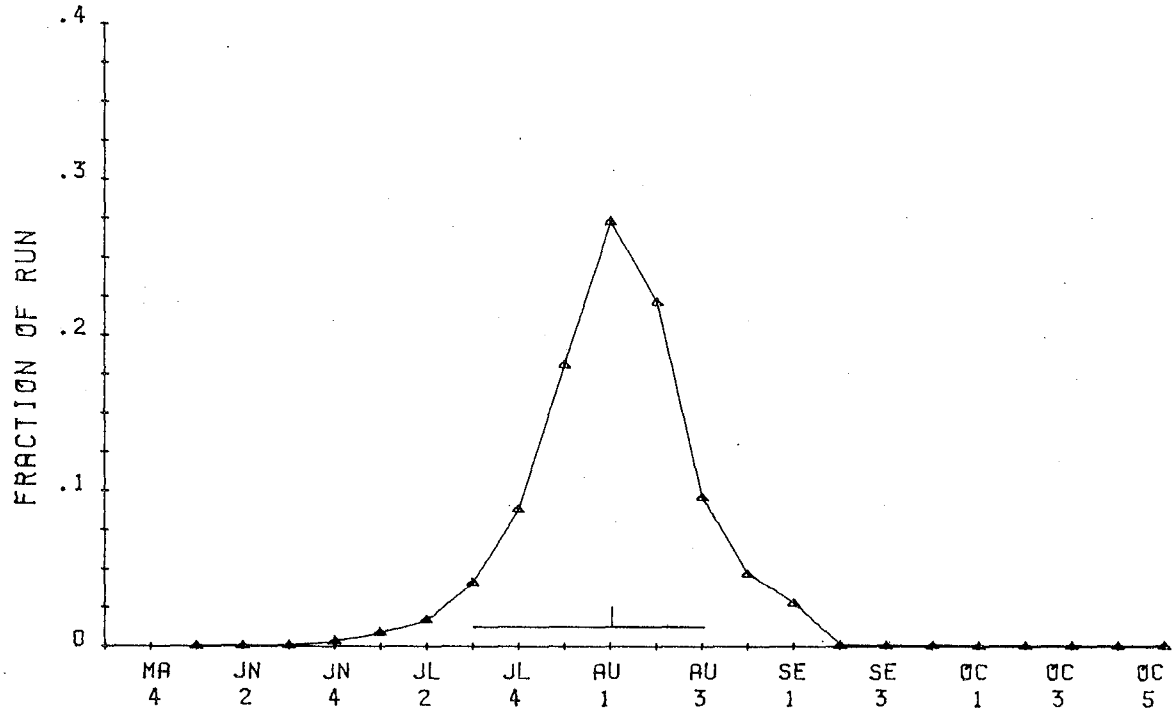
STOCK : DEAN CLOSED

YEAR	TOTAL RUN	TOTAL CATCH	TOTAL ESCAPE	HARVEST RATE	%CATCH AREA 7	%CATCH FISHER-FITZ
1970	115984	77484	38500	66.81	8.35	91.65
1971	25359	5159	20200	20.34	14.64	85.36
1972	48536	17336	31200	35.72	37.44	62.56
1973	60211	17711	42500	29.41	95.19	4.81
1974	65850	35850	30000	54.44	58.89	41.11
1975	14944	3844	11100	25.73	59.12	40.88
1976	38181	22106	16075	57.90	14.86	85.14
1977	30938	5738	25200	18.55	81.01	18.99
1978	23173	6723	16450	29.01	51.71	48.29
1979	32125	19550	12575	60.86	6.73	93.27
1980	163865	120665	43200	73.64	8.02	91.98
1981	151025	114675	36350	75.93	7.17	92.83
1982	49230	12580	36650	25.55	42.64	57.36

The mean run size of the Dean Closed chum stock represented approximately 4.7% of the mean run size of all Central Coast chum stocks combined between 1970 and 1982. Annual estimates of total run size showed no trend over the period but did vary by more than an order of magnitude. The smallest run size was recorded in 1975 at approximately 15,000 pieces and was followed five years later by the largest run size at over 160,000 pieces. Annual estimates of catch for the stock varied between 11,000 and 120,000 pieces and were highest in 1970, 1980 and 1981. Escapement estimates varied from a low of 11,100 pieces in 1975 to a high of 43,200 pieces in 1980. The mean harvest rate on the stock between 1970 and 1982 was 44.1%. The average median for entering run timing occurs during the first week of August.

Dean Closed Chum





Fisher - Fitzhugh Chum

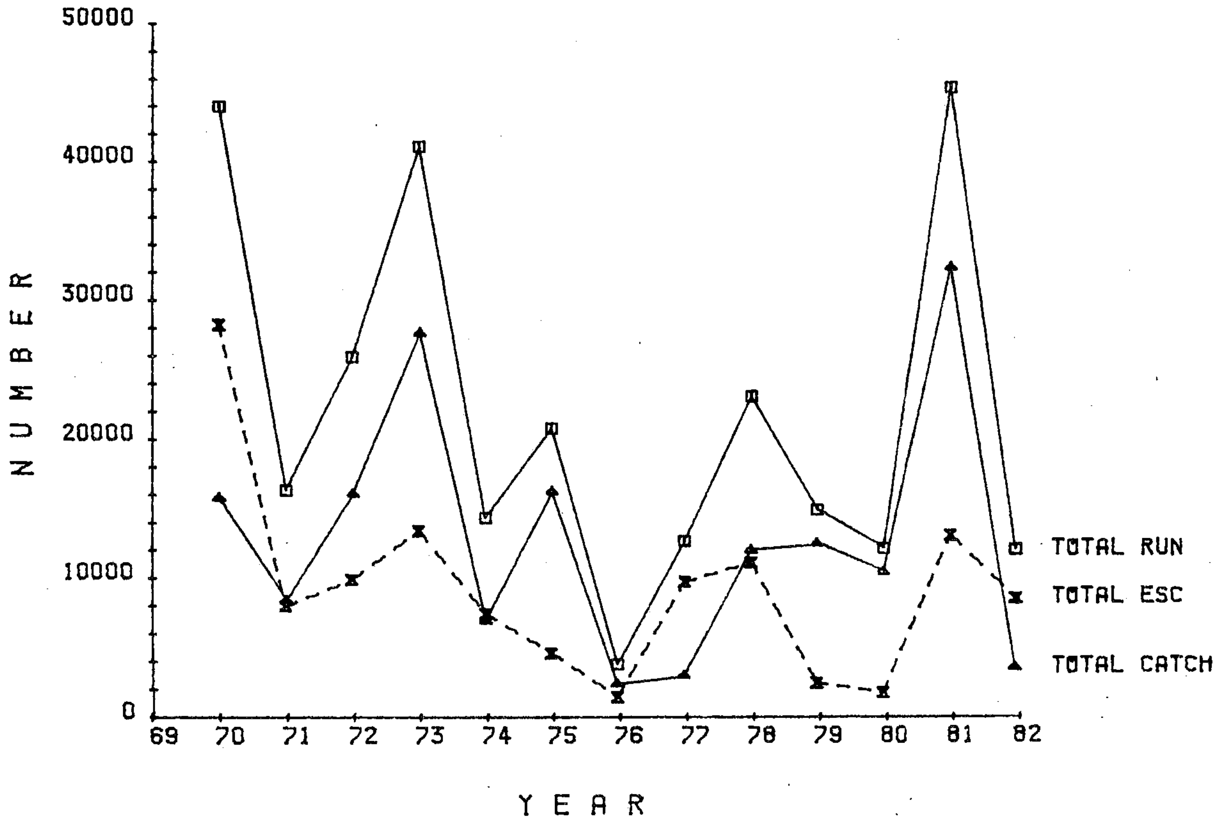
The Fisher - Fitzhugh chum stock aggregation originates from eight streams in the vicinity of King and Hunter Island in the central portion of statistical area 8. Evans Inlet, Hook Nose Creek and the Koeye River are the largest chum producing systems in the group and together account for approximately 80% of the total escapement of the stock. The Fisher - Fitzhugh chum stock is intercepted in the Fisher - Fitzhugh fishery located in Fisher Channel and Fitzhugh Sound.

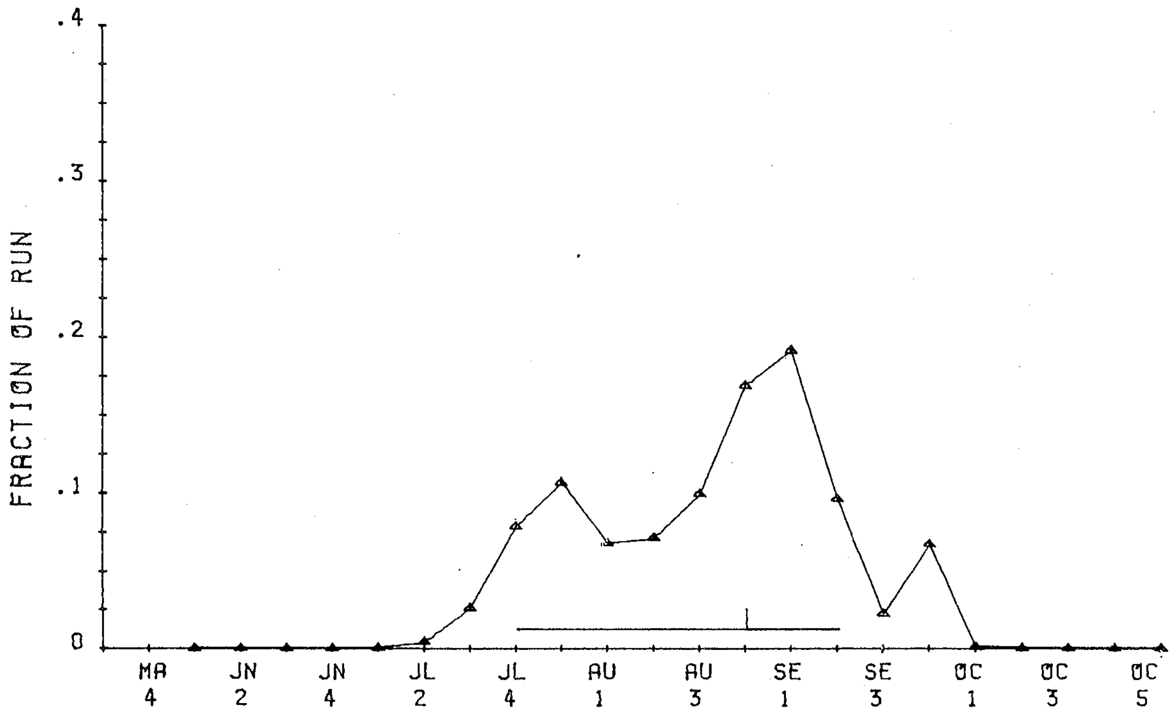
STOCK : FISHER-FITZHUGH

YEAR	TOTAL RUN	TOTAL CATCH	TOTAL ESCAPE	HARVEST RATE	%CATCH FISHER-FITZ
1970	44025	15775	28250	35.83	100.00
1971	16340	8365	7975	51.19	100.00
1972	25892	16042	9850	61.96	100.00
1973	41066	27691	13375	67.43	100.00
1974	14309	6909	7400	48.29	100.00
1975	20778	16203	4575	77.98	100.00
1976	3732	2332	1400	62.48	100.00
1977	12638	2938	9700	23.25	100.00
1978	23075	11975	11100	51.90	100.00
1979	14849	12449	2400	83.84	100.00
1980	12104	10404	1700	85.96	100.00
1981	45281	32271	13010	71.27	100.00
1982	11969	3469	8500	28.98	100.00

The Fisher - Fitzhugh chum stock is small, accounting for less than 2% of the mean run size of all Central Coast chum stocks combined between 1970 and 1982 and 5% of the mean run size of all Area 8 stocks combined over the same period. Both run size and catch varied by approximately an order of magnitude between 1970 and 1982. There was no trend evident during this period although estimates of both run size and catch were consistently low between 1974 and 1980. The largest run size and catch were recorded in 1981 at approximately 45,000 and 32,000 pieces respectively. The lowest estimate of run size, occurring in 1976, was less than 4,000 pieces. Escapement estimates declined discontinuously from a high of aproximately 28,000 pieces in 1970 to a low of 1,400 pieces in 1976. Escapement of the Fisher - Fitzhugh chum stock subsequently recovered and averaged approximately 8,000 pieces between 1977 and 1982. The mean harvest rate on the stock between 1970 and 1982 was 57.7%. The average median for entering run timing at the Fisher - Fitzhugh fishery occurs during the fourth week of August.

Fisher-Fitzhugh Chum





Bentinck Chum

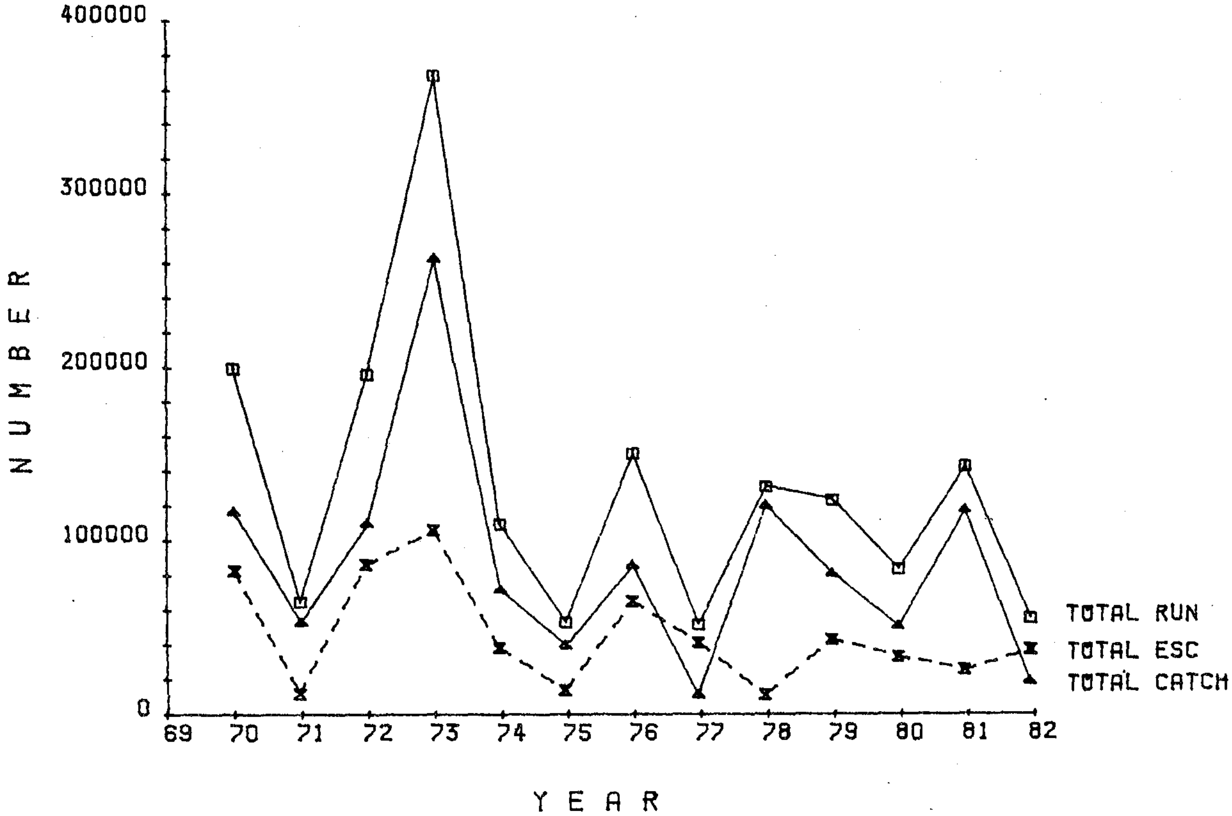
The Bentinck Chum stock aggregation originates from eight tributaries of North and South Bentinck Arm in statistical area 8. The Bella Coola River is the dominant chum producing system in the group and accounts for approximately 90 percent of the total escapement of the stock. The Bentinck chum stock is intercepted in three fisheries, two located in statistical area 8 and one in statistical area 7. The Fisher - Fitzhugh fishery, located in Fisher Channel and Fitzhugh Sound and the Bella Coola fishery, located in the vicinity of the North and South Bentinck Arm accounted for approximately 36 and 23% respectively of the total catch of the stock between 1970 and 1982. The remaining 41% of the catch was taken in the Area 7 fishery.

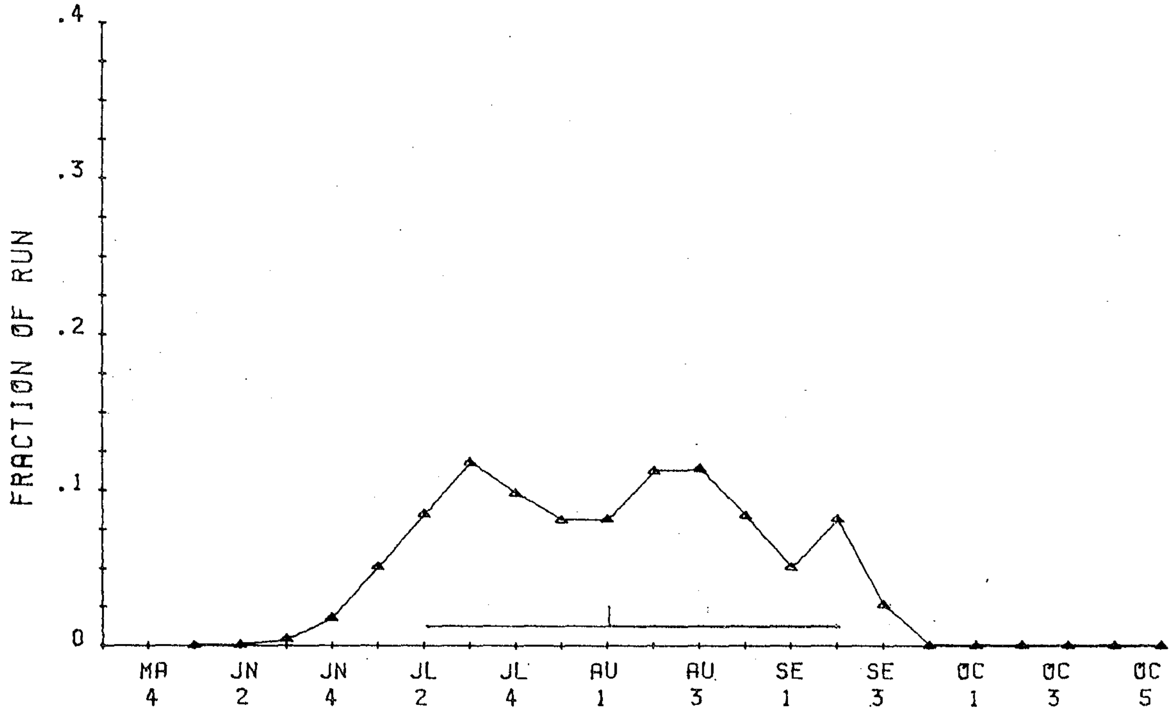
STOCK : BENTINCK

YEAR	TOTAL RUN	TOTAL CATCH	TOTAL ESCAPE	HARVEST RATE	%CATCH AREA 7	%CATCH FISHER-FITZ	%CATCH BELLA COOLA
1970	199173	116523	82650	58.50	27.66	44.05	28.29
1971	64441	52741	11700	81.84	60.72	21.95	17.33
1972	195763	109762	86000	56.07	57.53	26.79	15.68
1973	368580	262580	106000	71.24	70.05	23.98	5.97
1974	109532	71632	37900	65.40	60.71	27.42	11.87
1975	52912	39112	13800	73.92	51.65	28.76	19.59
1976	150101	85476	64625	56.95	30.09	58.24	11.67
1977	51493	10463	41030	20.32	43.77	53.60	2.63
1978	130953	119968	10985	91.61	19.47	7.14	73.39
1979	123325	80315	43010	65.12	16.46	62.09	21.46
1980	83231	50413	32825	60.57	16.97	38.52	44.51
1981	142706	117226	25480	82.14	19.57	46.12	34.31
1982	54833	17933	36900	32.70	50.41	30.72	18.87

The Bentinck chum stock is intermediate in size accounting for approximately 10% of the mean run size of all Central Coast chum stocks combined between 1970 and 1982 and one third of the mean run size of all statistical area 8 stocks combined over the same period. Total run size of the Bentinck chum stock aggregation was relatively stable between 1970 and 1982 averaging 113,000 pieces and fluctuating between 50,000 and 200,000 pieces. The only apparent anomaly occurred in 1973 when run size and catch exceeded 360,000 and 260,000 pieces respectively. Escapement estimates have fluctuated between 106,000 (1973) and 11,000 (1978) pieces and appear to have declined discontinuously between 1970 and 1982. Average escapement for the period between 1976 and 1982 was approximately 40 percent less than the average for the previous six years. The mean harvest rate on the stock between 1970 and 1982 was 62.8%. The average median for entering run timing occurs during the first week of August.

Bentinck Chum





Burke Chum

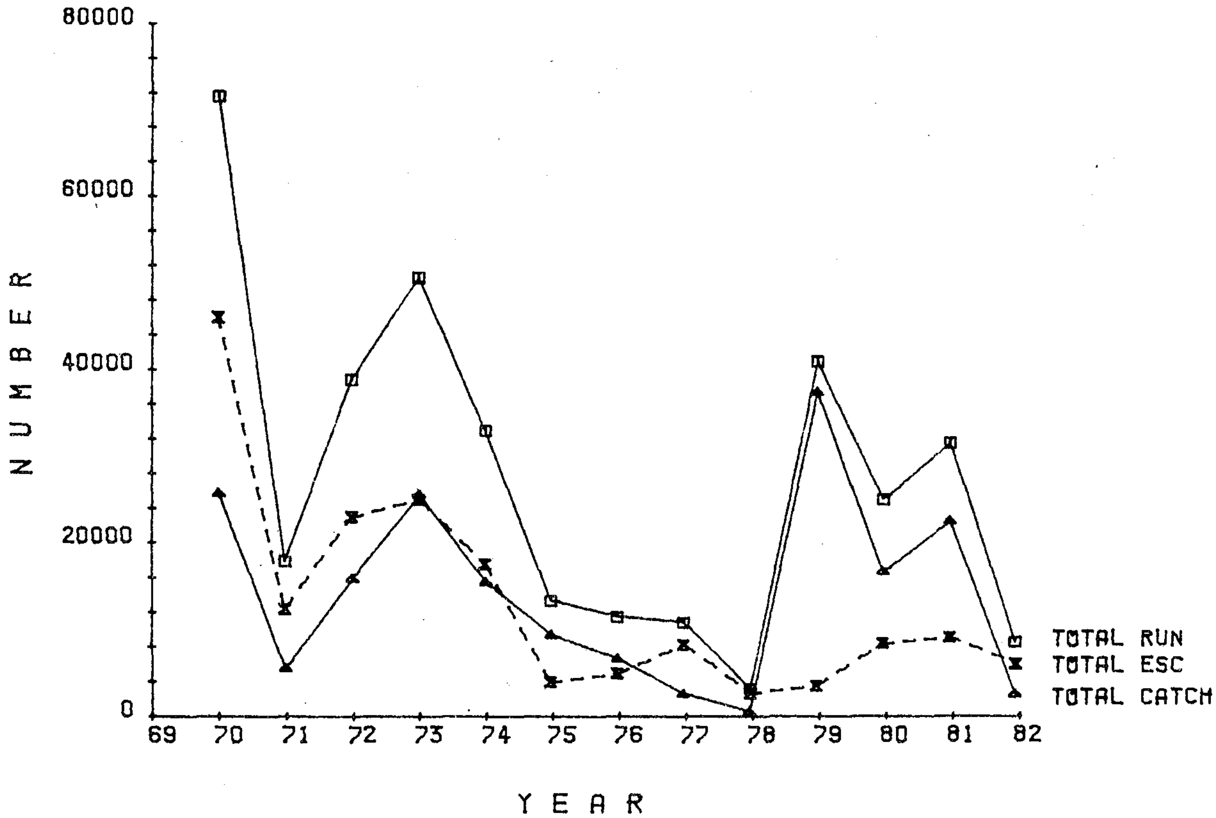
The Burke chum stock aggregation originates from three tributaries of Burke Channel in the central portion of statistical area 8. Kwatna River is the dominant chum producing system in the group and accounts for approximately 85% of the total escapement of the stock. The Burke chum stock is intercepted in the Fisher - Fitzhugh fishery located in Fisher Channel and Fitzhugh Sound in statistical area 8.

STOCK : BURKE

YEAR	TOTAL RUN	TOTAL CATCH	TOTAL ESCAPE	HARVEST RATE	%CATCH FISHER-FITZ
1970	71687	25687	46000	35.83	100.00
1971	17802	5452	12350	30.63	100.00
1972	38850	15850	23000	40.80	100.00
1973	50591	25591	25000	50.58	100.00
1974	32945	15445	17500	46.88	100.00
1975	13232	9332	3900	70.53	100.00
1976	11442	6542	4900	57.17	100.00
1977	10814	2514	8300	23.25	100.00
1978	3075	475	2600	15.44	100.00
1979	40846	37346	3500	91.43	100.00
1980	24957	16557	8400	66.34	100.00
1981	31498	22448	9050	71.27	100.00
1982	8448	2448	6000	28.98	100.00

The Burke chum stock is small accounting for approximately 2% of the mean run size of all Central Coast chum stocks combined between 1970 and 1982 and 7% of the mean run size of all statistical area 8 stocks during the same period. The total run size of the Burke chum stock has declined discontinuously from a high of almost 72,000 pieces in 1970 to less than 10,000 pieces in 1978 and 1982. There was no trend observed in catch estimates between 1970 and 1982 although there was a large degree of inter-year variability. The largest catch, more than 37,000 pieces, was taken in 1979. In addition, catches in excess of 20,000 pieces were taken in 1970, 1973 and 1981. Escapements have declined discontinuously from a high of 46,000 pieces in 1970 to less than 5,000 pieces in 1975, 1976, 1978 and 1979. The mean harvest rate on the stock between 1970 and 1982 was 48.4 percent. The average median for entering run timing at the Fisher - Fitzhugh fishery occurs during the third week of August.

Burke Chum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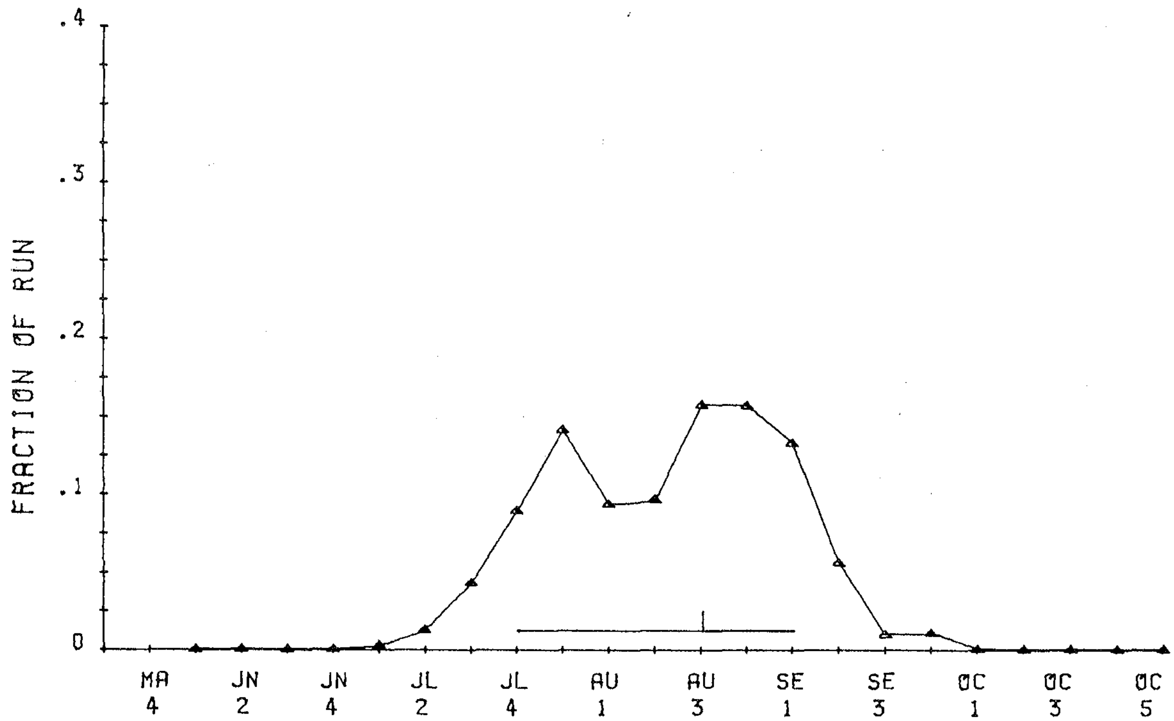
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Area 9 Chum

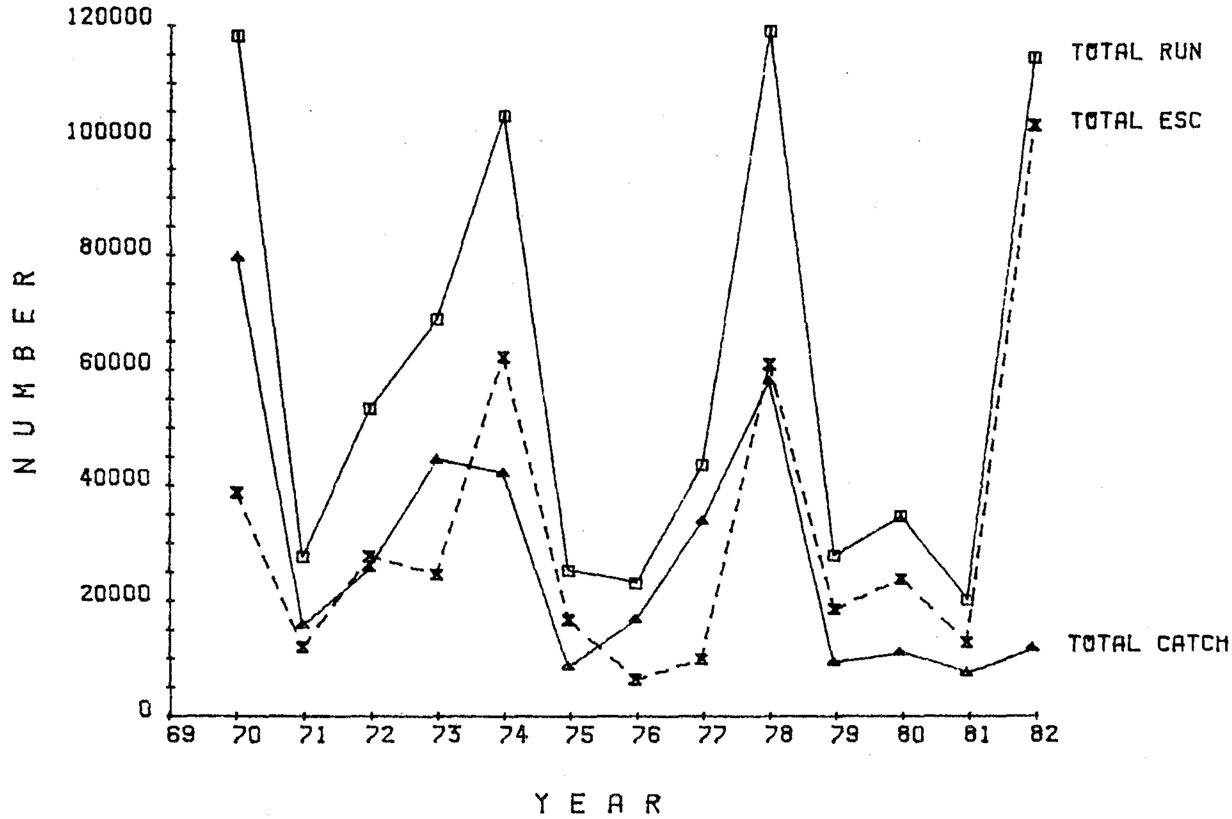
The Area 9 chum stock aggregation originates from 12 streams in statistical Area 9. The Wannock River is the dominant chum producing system in the group and accounts for approximately 37% of the total escapement of the stock. Escapement to three other systems, Clayak-Young and Niel Creek, Draney Creek and Lockhart-Gordon Creek, when combined with escapement to the Wannock system, accounts for almost 90 percent of the total escapement of the stock. The Area 9 chum stock is intercepted exclusively in the Area 9 fishery.

STOCK : AREA 9

YEAR	TOTAL RUN	TOTAL CATCH	TOTAL ESCAPE	HARVEST RATE	%CATCH AREA 9
1970	117962	79362	38600	67.28	100.00
1971	27470	15615	11855	56.84	100.00
1972	53120	25539	27581	48.08	100.00
1973	68648	44223	24425	64.42	100.00
1974	104028	41953	62075	40.33	100.00
1975	25020	8420	16600	33.65	100.00
1976	22963	16618	6345	72.37	100.00
1977	43440	33650	9790	77.46	100.00
1978	118601	57801	60800	48.74	100.00
1979	27745	9195	18550	33.14	100.00
1980	34600	10925	23675	31.57	100.00
1981	20015	7365	12650	36.80	100.00
1982	113860	11681	102179	10.26	100.00

The Area 9 chum stock is small representing approximately 4.5% of the mean run size of all Central Coast chum stocks combined between 1970 and 1982. The run size of the Area 9 chum stock exhibits a dramatic cyclical pattern, the period of which is four years. Total run sizes in excess of 100,000 pieces occurred in 1970, 1974, 1978 and 1982. The lowest estimates of run size for the intervening years ranged between 20,000 to 30,000 pieces. The distinct cyclical pattern appears to have arisen in the mid to late 1960's, however, the mechanism producing the cycle is unknown. Estimates of catch and escapement exhibited the same cyclical pattern shown for run size. The mean harvest rate on the stock was 47.7% between 1970 and 1982. The average median for entering run timing at the Area 9 fishery was the first week of August.

Area 9 Chum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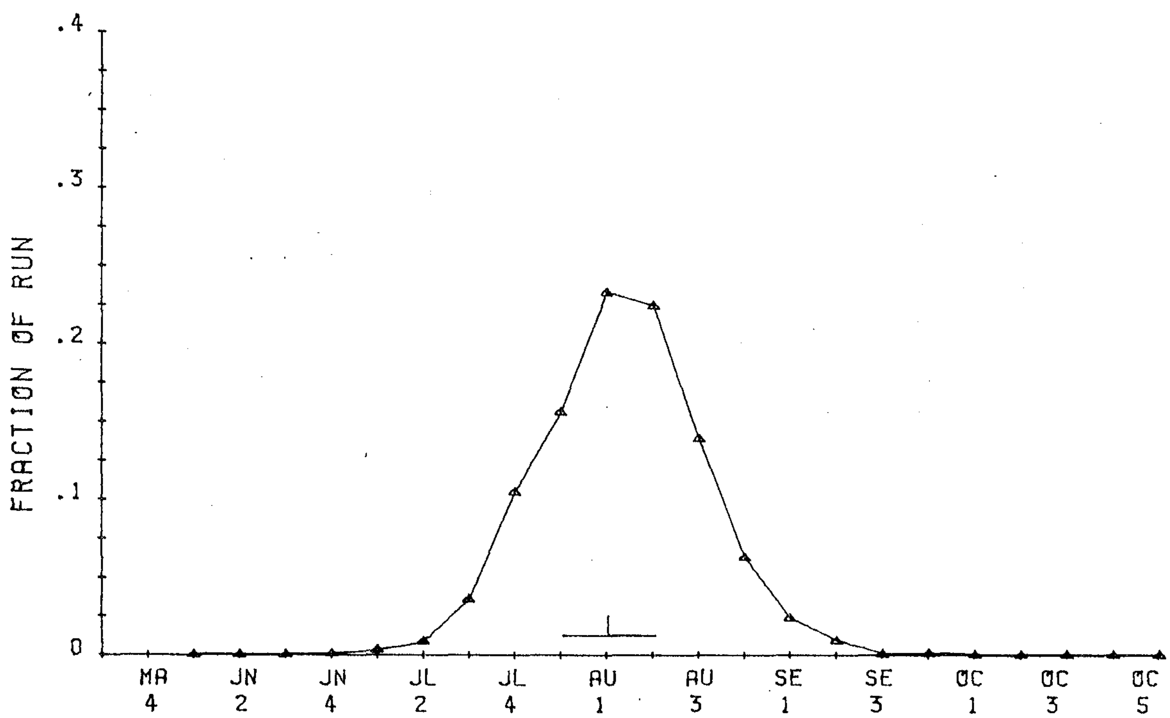
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Area 10 Chum

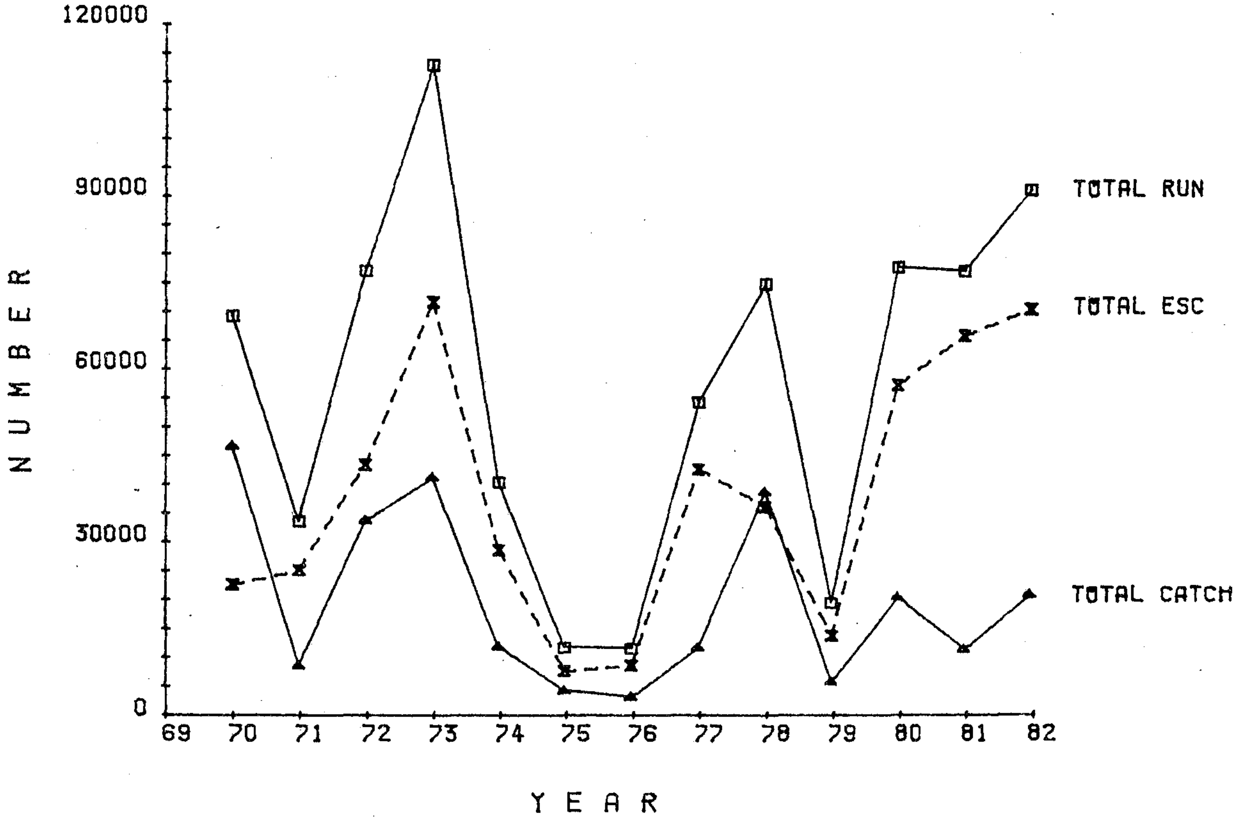
The Area 10 chum stock aggregation originates from Nekite River, Takush River and Walkum Creek in statistical area 10. The largest chum producing system among these three has changed historically although since 1970 the Nekite system has clearly dominated in most years and has averaged 70 to 95 percent of the total escapement of the stock. The Area 10 chum stock is intercepted exclusively in the Area 10 fishery.

STOCK : AREA 10

YEAR	TOTAL RUN	TOTAL CATCH	TOTAL ESCAPE	HARVEST RATE	%CATCH AREA 10
1970	69008	46508	22500	67.40	100.00
1971	33458	8458	25000	25.28	100.00
1972	76801	33551	43250	43.69	100.00
1973	112542	41043	71499	36.47	100.00
1974	40208	11708	28500	29.12	100.00
1975	11571	4071	7500	35.18	100.00
1976	11474	2974	8500	25.92	100.00
1977	54087	11587	42500	21.42	100.00
1978	74507	38507	36000	51.68	100.00
1979	19372	5622	13750	29.02	100.00
1980	77302	20301	57001	26.26	100.00
1981	76688	11188	65500	14.59	100.00
1982	90625	20625	70000	22.76	100.00

The Area 10 chum stock is small, accounting for approximately 4.2 percent of the mean run size of all Central Coast chum stocks combined between 1970 and 1982. The run size was highly variable and did not exhibit the cyclical pattern found in the adjacent Area 9 chum stock. The largest run size, approximately 112,000 pieces, was recorded in 1973 while run sizes of less than 12,000 pieces occurred in 1975 and 1976. Catch and escapement estimates were also highly variable and exhibited the same pattern found for run size. The mean harvest rate on the stock between 1970 and 1982 was 33.0 percent. The average median for entering run timing at the Area 10 fishery occurs during the third week of August.

Area 10 Chum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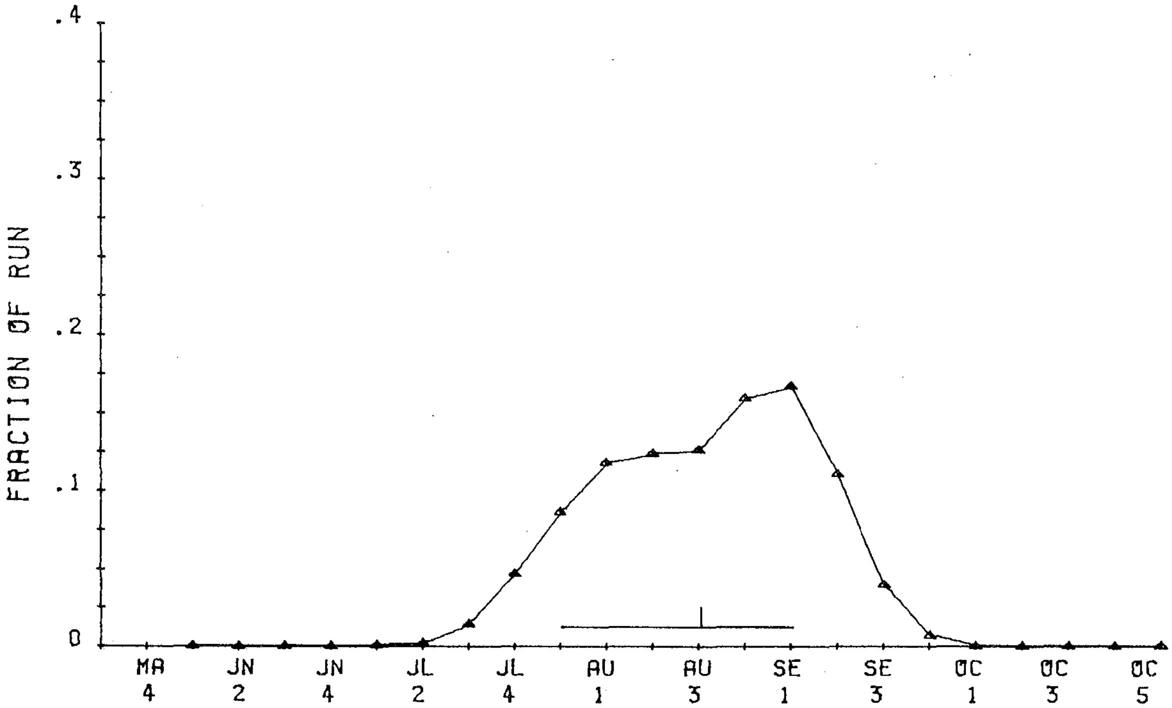
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Summary

This report has presented an analysis of chum salmon stocks in the Queen Charlotte Islands, North Coast and Central Coast regions of British Columbia, over the period 1970 to 1982. While there are several hundred genetically distinct chum stocks in the geographical region under consideration, from a fishery management perspective many of these can be aggregated into stock groupings, using such criteria as common location, timing or migration routing. Consequently the term 'stock' as used in this report refers either to a genetically distinct population or to an aggregation of such populations, depending on management requirements.

The results presented herein were obtained using the methodology of run reconstruction, a systematic procedure for bringing together and analysing a variety of input data, including both "hard data" such as catches and escapements, and informed judgements concerning timing, migration routing and interception rates. To our knowledge, these reconstruction inputs have never before been compiled in one report; while certainly liable to be improved and updated over time as new information is obtained, we believe they constitute the best available data base for many types of stock assessment analyses.

Table 16 summarizes the results of the reconstructions, displaying for each stock the trend in run size and escapement over the time period 1970-82. Since judging trends in data is a somewhat subjective exercise, we have chosen to emphasize the post-1974 information in making such judgements. In any case, the reader is encouraged to examine the stock-by-stock results and come to one's own conclusion.

Also shown in Table 16 is an estimate, for each stock, of the level of confidence we place in the results for that stock, measured as a 'high', 'medium' or 'low' level of confidence. The estimates are based largely on our perception of the reliability of the data base for each stock. A low level of confidence arises from poor escapement data, a poor understanding of escapement timing, and higher than average uncertainty about migration routes, diversion rates, and 'proportion local' for the catch in each fishery. In general, we place a lower level of confidence on the reconstruction results for chum salmon than those obtained for pink and sockeye in the same geographical regions. (Starr et. al., 1984; Henderson & Charles, 1984).

Qualitatively, three distinct phases emerge from the aggregate estimates of run size and escapement of Queen Charlotte Islands, North Coast and Central Coast chum (cf. Fig. 3, 5 and 7). Between 1970 and 1974 average run size and escapement were large, but both decreased percipitously in 1975. Following 1975 there was a gradual discontinuous increase in run size and escapement of Queen Charlotte Islands and Central Coast chum. Although the run size of North Coast chum also increased after 1975 the same trend was not evident in the aggregate escapement estimates.

The sharp decline in combined Queen Charlotte Islands chum runs between 1973 and 1975 (Fig. 3) led to dramatic reductions in catch levels, particularly in terminal areas. This action succeeded in maintaining escapements, which increased considerably since 1975. While declines in catch levels occurred for all Queen Charlotte Islands stock groups, with the exception of Area 2E

Table 16. Recent trends in chum stocks (run size and escapement) from the Queen Charlotte Islands, North Coast and Central Coast, together with estimates of confidence in the results for each stock.

Stock	Trend	Level of Confidence
Area 1	uncertain	low-medium
Area 2W	increasing	low-medium
Area 2E South	no trend	low-medium
Area 2E Skidegate	increasing	medium
Area 3 Late Run	no trend (run) decreasing (esc)	low
Area 3 Observatory Inlet	increasing/decreasing	low-medium
Area 3 Portland/Nass	increasing (run) decreasing (esc)	medium
Area 4	no trend (run) decreasing (esc)	medium
Area 5	uncertain	low
Gardner	no trend	medium
Kitimat	decreasing	medium
Douglas	increasing	medium
Laredo Sound	no trend	low-medium
Fraser-Graham	no trend	low-medium
Area 7	decreasing	medium
Dean Open	decreasing	medium
Dean Closed	increasing	medium
Fisher-Fitzhugh	no trend (run) decreasing (esc)	medium
Bentinck	no trend	medium
Burke	decreasing	medium
Area 9	no trend	medium
Area 10	increasing	medium

Skidegate chum, the characteristic drop in run sizes between 1973 and 1975 was driven by Area 2W and Area 2E South. The latter stock remained depressed over the post-1975 period, while the Skidegate stock led the partial recovery in aggregate stock strength. The relatively small Area 1 chum stock was essentially unexploited in recent years, but the trend for this stock is unclear.

While the aggregate North Coast chum population follows the general pattern discussed above (Fig. 5), with high run sizes in the early 1970s dropping between 1973 and 1975 to lower levels thereafter, the results differ from those of the Queen Charlotte Islands in three principal respects: (i) low stock sizes in 1970 and 1971, (ii) a relatively strong post-1975 recovery in run sizes (up to 1980) and (iii) a steady decline in recent escapement levels, with no evident upturn. Hence the North Coast results cannot be seen simply as a dramatic drop from high to low stock sizes with subsequent rebuilding, although this is the case to a certain extent. All the North Coast stock groupings identified in this report show a declining trend in escapements between the mid-1970s and 1982. Over these more recent years, Area 4 and Area 5 run sizes also display decreases, while stock groups in Area 3 show trends ranging from an increase in Portland/Nass run sizes to an increasing/decreasing pattern for chum runs in Observatory Inlet.

Between 1970 and 1973 Central Coast run sizes were large, and in excess of two million pieces in three of the four years (Fig. 7). Following 1973 there was an abrupt decline to approximately 600,000 pieces in 1975 and then a gradual but discontinuous increase through 1982. The three phases were evident to some degree in most of the larger Central Coast chum stocks (ie. Gardner, Kitimat, Douglas, Area 7 and Bentinck) but in only a few of the smaller stocks. Estimates of aggregate catch and aggregate escapement for the Central Coast stocks also exhibited the three phases described above. A particularly unique feature of Central Coast chum is the dramatic cyclical nature of run size in the Area 9 stock. The four year cycle first appeared in the 1960s although the mechanism leading to its initiation and maintenance is unknown.

We have attempted in this report to bring together and analyze relevant data on northern British Columbia chum salmon stocks. While the level of confidence in the results is somewhat limited, information has been produced that will aid in the determination of stock status, relative to 'optimal' levels, and the potential for enhancement of northern chum stocks.

Updating of the input data used in this report is to be encouraged, as new information becomes available over time. We have indicated areas where data of better quality than currently exists would be particularly helpful both to stock assessment and to management. This report should be seen therefore, as providing both an indication of past performance in the fisheries, and a suggestion of possible directions for further research.

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