

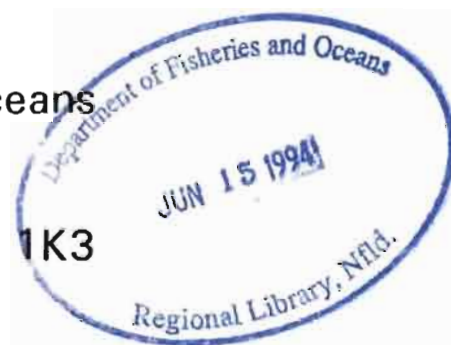


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Biochemical Genetic Stock Identification of Chum Salmon in Southern British Columbia, 1993

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1994

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Canadian Data Report of
Fisheries and Aquatic Sciences No. 929

April 1994

BIOCHEMICAL GENETIC STOCK IDENTIFICATION
OF CHUM SALMON IN SOUTHERN
BRITISH COLUMBIA, 1993

by

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Cat. No. FS 97-13/929E ISSN 0706-6465

Correct citation for this publication:

Wyllie, E.S, S.C. Di Novo, L. Hop Wo and W.H. Luedke. 1994.
Biochemical Genetic Stock Identification of Chum Salmon in
Southern British Columbia, 1993. Can. Data Rep. Fish.
Aquat. Sci. No. 929: 13p.

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ABSTRACT

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Biochemical Genetic Stock Identification of Chum Salmon in
Southern British Columbia, 1993. Can. Data. Rep. Fish.
Aquat. Sci. No. 929: 13p.

Genetic stock identification is used by the Department of Fisheries and Oceans in estimating chum salmon stock composition in Southern British Columbia. In 1993 a total of 6,033 fish samples were collected from test fisheries and/or commercial net fisheries from three fishing areas (Johnstone Strait, Mid Vancouver Island and Nitinat). Stock composition results are presented.

Key words: chum salmon, genetic stock identification, stock composition, fishery management, Southern British Columbia.

RÉSUMÉ

Wyllie, E.S, S.C. Di Novo, L. Hop Wo and W.H. Luedke. 1994.
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Southern British Columbia, 1993. Can. Data. Rep. Fish. Aquat.
Sci. No. 929 : 13p.

L'identification génétique des stocks permet au ministère des Pêches et des Océans d'estimer la composition des stocks de saumon kéta dans le sud de la Colombie-Britannique. En 1993, on a prélevé 6,033 échantillons au total dans des pêches d'essai ou commerciales de trois secteurs de pêche (détroit de Johnstone, partie centrale de l'Île Vancouver et Nitinat). Les résultats sont présentés dans cet article.

Mots-clés : saumon kéta, identification génétique des stocks, composition des stocks, gestion des pêches, sud de la Colombie-Britannique.

INTRODUCTION

Genetic stock identification (GSI) methods have been used to determine stock composition in Canadian chum fisheries since 1981 (Beacham et al. 1985) with results reported annually.

The resulting stock composition estimates are used in a variety of ways. Estimates of interception of U.S. bound chum salmon are required to meet the terms of the Pacific Salmon Treaty. Annual estimates of stock composition are used in post season stock assessment and stock reconstruction activities. Weekly estimates of stock composition contribute to knowledge of migration run timing and migration routes. Weekly estimates of catch by stock are also used as indices of total return for important stocks such as the Fraser River and Qualicum area stocks.

Areas and commercial fisheries which are sampled include Johnstone Strait, Mid Vancouver Island and Nitinat (Figure 1) and are selected based on a potential for intercepting U.S. bound chum salmon.

This report presents chum stock composition estimates for test and commercial net fisheries from 1993. Methods, analysis and results are reported below. In 1993, inherent bias in the estimates from the Johnstone Strait and Qualicum fisheries was determined through simulation by analyzing fishery samples of known composition.

METHODS

(A) Collection

In 1993, a total of 6,033 chum were sampled from three fishing areas in southern British Columbia. Sampling occurred from mid-September to early November. Chum were collected from two commercial gear types (gillnet and seine), and sampled from commercial fishing boats, fish processing plants, or Department of Fisheries and Oceans (DFO) chartered fishing vessels.

Briefly, samples collected consist of heart, liver, and muscle tissues from freshly caught adult chum salmon. Muscle tissue was extracted using a coring technique described in Hop Wo et al. (1991). The individually packaged tissues were then frozen to help prevent protein degeneration. Protein analysis was provided by a consultant, using the horizontal starch gel technique described by Utter et al. (1974).

Chum salmon were sampled from the following three fishing areas (Fig. 1): Johnstone Strait (Areas 12 and 13); Mid Vancouver Island (Area 14) and Nitinat (Area 21). In general, samples were obtained on a per fishery or weekly stratified basis. Sample size ranged from 150-200 chum.

(i) Johnstone Strait

In Johnstone Strait (Areas 12 and 13), stock identification sampling was conducted on both test and commercial fishing catches. Tissue samples from the Johnstone Strait test fishery were

collected each week in conjunction with stock abundance testing at predetermined sites as described in Vreeling et al. (1987). Sampling commenced mid-September and continued until early November. A total of 2,355 samples were collected from two vessels over a nine-week period. Each vessel collected approximately 150 chum samples per week.

The commercial fisheries were sampled at four landing sites in Vancouver (Canadian Fishing Co., B.C. Packers Ltd., J.S. MacMillan Fisheries Ltd. and Ocean Fisheries Ltd.), for a total of 1,651 chum. The Johnstone Strait fishery occurred in Statistical Areas 12 and 13. The number of fish collected from each Statistical Area was weighted according to the catch distribution.

In 1993, three commercial fisheries were conducted in Johnstone Strait. The first fishery was conducted on September 22 with a total of 595 fish sampled (approximately 200 fish from each of three landing sites). The objective for this fishery was to sample equal proportions from each of Areas 12 and 13, based on catch distribution. This preferred mixture of 50% for each Area, was achieved. During the second fishery on October 25, 520 fish were sampled. The preferred mixture of 40% and 60% between Areas 12 and 13, respectively, was not achieved. To reflect the catch distribution, only 400 fish of the total sample were used to determine the stock composition of this fishery. During the final fishery on November 4, 536 chum were sampled. The preferred mixture between Areas 12 and 13 was again 40% and 60%, respectively. However due to sampling complications, a 25% and 75% mixture was obtained.

A total of 4,006 chum were sampled from Johnstone Strait test and commercial fisheries.

(ii) Mid Vancouver Island

The Mid Vancouver Island (Area 14) sampling program occurs aboard packing vessels located in the fishing area. Chum were collected from three gillnet fisheries which occurred on October 19, October 24 and November 3, 4. The samples were collected according to three sub-areas, referred to non-technically as 'inside', 'outside' and 'upper' sub-areas. A total of 898 fish were sampled which included: 458 fish from the inside, 290 fish from the outside and 150 chum from the upper sub-area.

Harvesting continued until late November by gillnet and seine. These terminal "clean up" fisheries commenced on November 7 for gillnets and November 21 for seines. These latter fisheries occurred near primary spawning streams on Mid Vancouver Island and were not sampled for GSI.

(iii) Nitinat

Commercial fisheries in the Nitinat area (Areas 21/121) commenced September 27. Gillnet fisheries were conducted; starting September 27 for four days, October 4 for four days and October 11 for two days. Seine fisheries were conducted over three days,

October 23, 24 and 26. Combined seine and gillnet fisheries commenced October 27 and continued through to November 10.

Samples of approximately 200 fish per week were sampled from the commercial fisheries or from test fisheries during weeks with no commercial fishery. Samples were collected from packers and/or seine vessels which delivered to processing plants in Vancouver. Samples generally represented the catch from 1-3 days prior to the sampling date. All the samples represented single gear fisheries, including one sample from a test fishery on October 21.

A total of 1,129 chum were sampled over six weeks from Nitinat fisheries.

(iv) Other Areas

Chum fisheries frequently occur in other discreet terminal areas. In 1993 terminal chum fishing occurred at Jervis Inlet (Area 16), Nanaimo (Area 17), Cowichan (Area 18), Nootka (Area 25), and Fraser (Area 29). Several of these areas (Nanaimo and Cowichan) have received GSI sampling in the past and show only small interceptions (less than 1%) of non-Canadian stocks (Hop Wo et al. 1991, 1992).

No sampling was consequently conducted in 1993 in these terminal chum fishing areas.

(B) Analysis

After collection, the frozen chum tissue samples were sent to a contract laboratory for protein analysis. The tissues were analyzed for protein variation. The seven loci analyzed and coded are listed using nomenclature described by Shaklee et al. 1990: IDH-1 (1.1.1.42); PGDH (1.1.1.44); ME (1.1.1.39); G3PDH (1.1.1.8); IDH-3 (1.1.1.42); MPI (5.3.1.8); and Pep (3.4.-.-,) leucyl glycyl glycine substrate. This information was coded and returned to DFO for comparison to appropriate baseline samples.

The information (or mixture sample), from each fishery was compared to a baseline which includes all possible stock contributors to the fishery based on knowledge of migration routes and abundance. For Johnstone Strait and Qualicum fisheries, the baseline used includes stocks originating from Johnstone Strait, Georgia Strait, Fraser River and Washington. For Nitinat fisheries, the baseline used includes West Coast Vancouver Island, Georgia Strait, Fraser River and Washington stocks. The individual baseline stocks and respective allelic frequencies are detailed in Hop Wo et al. (1992).

Fish in the mixture sample were allocated, by analysis, to a stock in the baseline, then pooled into stock groupings. Fishery compositions were estimated by analysis using the allocate pool method for genotypic frequencies described by Fournier et al. (1984), and outlined by Beacham et al. (1987). Procedures for analysis using a maximum likelihood computer model are outlined in McKinnell (1990). The standard deviations of the stock point estimates were estimated by boot strapping, where new mixture samples were created by randomly sampling with replacement, the

original mixture sample and baseline groupings. Computer model parameters (convergence criteria), were set at $10 \times e^{-10}$ for stock point estimates and $10 \times e^{-7}$ for boot strapping, which produce the most accurate point estimates within a reasonable run time.

Sampling and electrophoretic processing checks were conducted by duplication and submission of samples. The duplicated samples were analyzed and the scores and results were then compared. Sampling consisted of isolating 100 chum samples from a commercial seine landing in Vancouver. The three tissues types, (heart, liver and muscle), were sampled twice. Each of the two identical fish samples were assigned corresponding labels. One of the duplicate samples was processed locally, while the other corresponding sample was processed by the Washington Department of Fisheries laboratory.

The samples were compared by counting the differences in genotypic scores. The percentage difference was calculated as the total count divided by the total scores, (number of fish times the number of loci). The missing scores in either sample did not constitute a difference and were not included in the percentage.

RESULTS

The GSI (electrophoretic) stock composition results, for the three commercial fishery locations, are presented in Tables 1 to 4.

The results of GSI analysis are expressed as percentages by major stock area: Fraser River, Johnstone Strait, Strait of Georgia, United States and West Coast Vancouver Island. Included with stock composition estimates are the following: area of collection, sample date and size, gear type collected from, and estimates of standard deviation.

Results of the processing check suggest a minimal difference in genotypic scores of 2.0% between the duplicate samples, (Table 5).

Previous processing checks have revealed differences of 2.6% and 1.7% for two 1987 samples and 0.6% for one 1988 sample (Phelps 1989).

The 1990 control comparison of a Johnstone Strait commercial sample resulted in a 0.9% difference.³ The 1991 control comparison of a Nitinat commercial sample resulted in 1.2% difference.⁴ The 1992 control comparison⁵ of a Johnstone Strait test sample resulted in a 1.8% difference.

³Hop Wo memo, 1990 Chum Commercial Electrophoretic Control Comparison, April 16, 1991.

⁴Hop Wo memo, 1991 Chum Commercial Electrophoretic Control Comparison, March 20, 1992.

⁵Hop Wo memo, 1992 Chum Test Seine Electrophoretic Control Comparison, February 4, 1993.

ACKNOWLEDGEMENTS

Senior management technicians A. Stefanson, A. Sewid and J. Mitchell coordinated sampling and test fishing. Samples were collected by: K. Anderson, C. Annand, A. Dunlop, S. Kitchener, L. Naylor, L. Sewid, and S. Tooker. Skippers of chartered vessels included A. Hunt, "Moon" Stauffer and J. Malatestenic. Protein analysis was provided by Alphagen Diagnostics. Protein analysis of the processing check duplicate was provided by Stevan R. Phelps of the Washington Department of Fisheries. Commercial sampling was assisted by J.O. Thomas and Associates.

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Table 1. Combined weekly chum stock composition in Johnstone Strait (Area 12) seine test fishery, 1993 (1).

Week	Sample Date	Gear (3)	Sample Size	Stock Composition (2)					
				% FR		% JS,GS		% US	
				%	(1SD)	%	(1SD)	%	(1SD)
9/3	SEP13-17	TSN	299	19.0	(12.3)	81.0	(12.4)	0.0	(0.4)
9/4	SEP24,25	TSN	150	19.9	(17.5)	80.1	(17.1)	0.0	(2.6)
10/1	SEP27-OCT1	TSN	300	55.4	(16.9)	44.6	(16.5)	0.0	(2.7)
10/2	OCT2-8	TSN	302	9.6	(16.6)	87.7	(14.7)	2.6	(5.3)
10/3	OCT10-15	TSN	304	8.6	(12.1)	73.6	(9.7)	17.8	(9.4)
10/4	OCT18-21	TSN	307	25.4	(17.7)	70.7	(16.0)	3.9	(5.1)
10/5	OCT25-28	TSN	301	11.6	(13.7)	86.9	(13.4)	1.5	(5.6)
11/1	OCT31-NOV1-5	TSN	256	50.2	(18.5)	40.2	(17.1)	9.5	(11.6)
11/2	NOV8-9	TSN	136	3.5	(6.2)	89.0	(10.0)	7.5	(9.1)

(1) Stock composition from electrophoretic samples taken in test fisheries. Point estimate (%) for week and standard deviation (1SD) from bootstrap simulation.

(2) Area: FR - Fraser River; JS,GS - Johnstone Strait, Strait of Georgia; US - Washington State.

(3) Gear: TSN - test seine.

Table 2. Chum stock composition in Johnstone Strait (Areas 12 & 13) commercial seine fisheries, 1993 (1).

Week	Sample Date	Sample Size	Area	Gear(3)	Stock Composition (2)					
					% FR		% JS,GS		% US	
					%	(1SD)	%	(1SD)	%	(1SD)
<u>Individual Samples(4)</u>										
9/4	SEP22	198	12,13	CSN	22.5	(16.4)	77.5	(16.3)	0.0	(2.7)
9/4	SEP22	200	12	CSN	0.0	(10.1)	100.0	(10.3)	0.0	(2.4)
9/4	SEP22	197	13	CSN	20.6	(12.6)	78.2	(12.6)	1.1	(0.1)
10/5	OCT25,26	200	12,13	CSN	33.7	(23.6)	62.0	(22.9)	4.2	(6.6)
10/5	OCT25,26	200	12,13	CSN	2.6	(13.7)	92.3	(16.6)	5.0	(13.4)
10/5	OCT25,26	120	13	CSN	19.3	(16.4)	77.8	(15.5)	2.9	(4.8)
11/1	NOV4	196	12,13	CSN	39.9	(14.5)	55.9	(12.6)	4.2	(7.4)
11/1	NOV4	150	13	CSN	10.5	(16.8)	74.2	(19.0)	15.4	(10.1)
11/1	NOV4	190	12,13	CSN	13.7	(13.4)	75.7	(12.5)	10.7	(6.1)
<u>Combined by Fishery</u>										
9/4	SEP22	595	12,13	CSN	1.8	(12.0)	97.8	(11.9)	0.4	(1.3)
10/5	OCT25,26	400	12,13	CSN	18.9	(12.5)	75.4	(13.3)	5.7	(6.4)
11/1	NOV4	386	12,13	CSN	26.7	(10.4)	66.0	(11.1)	7.3	(4.0)

(1) Stock composition from electrophoretic samples taken in commercial fisheries. Point estimate (%) for week and standard deviation (1SD) from bootstrap simulation.

(2) Area: FR - Fraser River; JS,GS - Johnstone Strait, Strait of Georgia; US - Washington State.

(3) Gear: CSN - commercial seine.

(4) Each sample represents a different processing plant.

Table 3. Chum stock composition in Mid Vancouver Island (Area 14) commercial gillnet fisheries, 1993 (1).

Week	Sub-areas Sampled (3)	Sample Dates	Sample Size	Gear (4)	Stock Composition (2)					
					% FR		% JS,GS		% US	
					%	(1SD)	%	(1SD)	%	(1SD)
10/4	14-(i)	Oct 19	150	CGN	19.0	(26.5)	72.1	(23.1)	9.0	(9.8)
10/4	14-(o)	Oct 19	150	CGN	14.6	(18.2)	76.5	(16.5)	8.9	(9.9)
10/4	14-(u)	Oct 19	150	CGN	0.1	(10.3)	98.6	(10.4)	1.3	(2.3)
10/5	14-(i)	Oct 24	158	CGN	6.2	(12.5)	87.4	(11.4)	6.4	(5.8)
10/5	14-(o)	Oct 24	140	CGN	0.0	(8.0)	91.8	(10.6)	8.1	(7.5)
11/1	14-(i)	Nov 3,4	150	CGN	15.03	(13.4)	84.9	(13.4)	0.0	(0.0)

(1) Stock composition from electrophoretic analysis of samples taken from commercial gillnet catch. Point estimate (%) for week and standard deviation (1SD) from bootstrap simulation.

(2) Area : FR - Fraser River; JS,GS - Johnstone Strait, Strait of Georgia; U.S. - Washington State.

(3) Sub areas : 14-4,5 (o) - outside area, (eastern);
14-4,5(i) - inside area, (western); 14-9,10(u) - upper area,(northern).

(4) Gear : CGN - commercial gillnet.

Table 4. Weekly chum stock composition in Nitinat (Area 21) commercial and test fisheries, 1993 (1).

Week	Sample Date	Sample Size	Gear (3)	Stock Composition (2)							
				%FR		%GS		%US		%WCVI	
				%	(1SD)	%	(1SD)	%	(1SD)	%	(1SD)
10/1	Sep 28, 29	203	CGN	0.7	(3.6)	16.7	(9.6)	1.9	(3.5)	80.6	(10.5)
10/2	Oct 4, 5, 6	200	CGN	0.8	(2.6)	23.9	(10.6)	0.0	(0.0)	75.3	(10.8)
10/3	Oct 11, 12	200	CGN	0.0	(0.3)	11.8	(9.1)	0.0	(2.0)	88.2	(9.6)
10/4	Oct 21	200	TSN	0.1	(3.8)	9.0	(8.8)	8.9	(5.3)	82.0	(9.5)
10/5	Oct 26, 27	201	CSN	0.1	(2.9)	5.3	(5.5)	3.3	(3.7)	91.3	(6.5)
11/1	Nov 6,7	125	CSN	21.0	(13.4)	12.6	(12.7)	0.0	(0.4)	66.3	(11.8)

(1) Samples collected at landing site. Point estimate (%) for week and standard deviation (1SD) from bootstrap simulation.

(2) Area: FR - Fraser River; GS - Georgia Strait; U.S. - Washington State; WCVI - West Coast Vancouver Island.

(3) Gear: CGN - commercial gillnet, CSN - commercial seine, TSN - test seine

Table 5. 1993 Electrophoretic Processing Check Comparison

SAMPLE SIZE	100
POSSIBLE SCORES	700
MISSING SCORES	1
TOTAL SCORES	699

LOCI	Number of Differences	Percent of Differences
IDH1	1	0.1%
6PG	0	0.0%
ME	0	0.0%
AGP	4	0.6%
IDH3	1	0.1%
PMI	7	1.0%
LGG	1	0.1%
TOTAL	14	2.0%

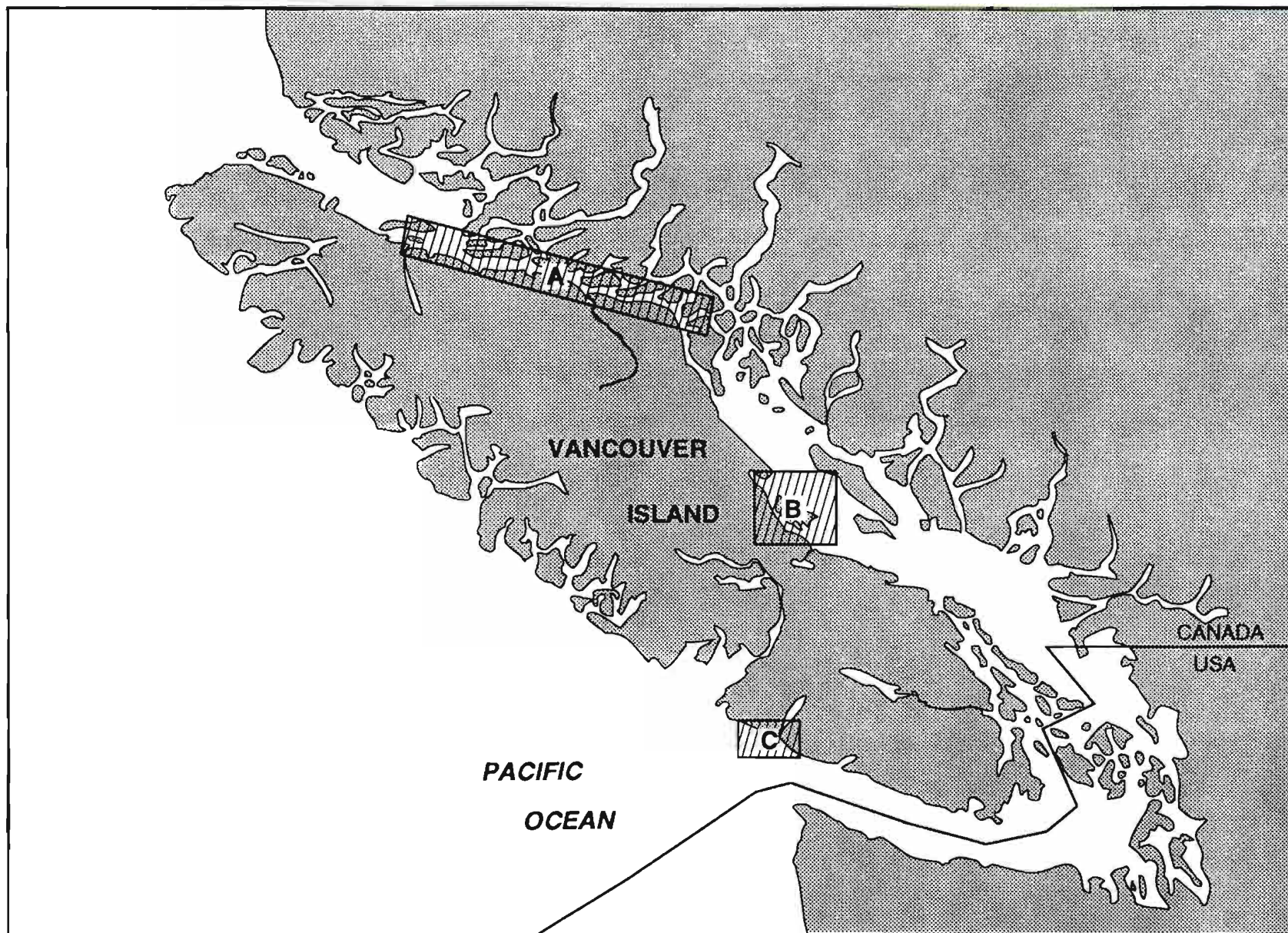


Figure 1. Regions of Chum Sampling in 1993.

(A) Johnstone Strait (B) Mid Vancouver Island (C) Nitinat

