Biochemical Genetic Stock Identification of Chum Salmon in Southern British Columbia 1992

L. Hop Wo, S.C. Di Novo and W.H. Luedke

Department of Fisheries and Oceans
Fisheries Branch
South Coast Division
Nanaimo, British Columbia V9T 1K3

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BIOCHEMICAL GENETIC STOCK IDENTIFICATION

OF CHUM SALMON IN SOUTHERN

BRITISH COLUMBIA 1992

by

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Department of Fisheries and Oceans

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ABSTRACT

Hop Wo, L., S.C. Di Novo and W.H. Luedke. 1993. Biochemical Genetic Stock Identification of Chum Salmon in Southern British Columbia 1992. Can. Data. Rep. Fish. Aquat. Sci. No. 900: 17p.

Genetic stock identification (GSI) is used by the Department of Fisheries and Oceans in estimating chum stock composition. In 1992 approximately 6,700 fish samples were collected from three fishing areas (Johnstone Strait, Mid Vancouver Island and Nitinat). Samples were collected from test fisheries and/or commercial fisheries. Stock composition results are presented.

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

RÉSUMÉ

Hop Wo, L., S.C. Di Novo et W.H. Luedke. 1993. Biochemical Genetic Stock Identification of Chum Salmon in Southern British Columbia 1992. Can. Data. Rep. Fish. Aquat. Sci. No. 900: 17p.

Le ministère des Pêches et des Océans a recours à l'identification génétique des stocks (GSI) pour évaluer la composition des stockes de saumon kéta. En 1992, environ 6 700 échantillons de poissons provenant de quatre secteurs de pêche (détroit de Johnstone, partie centrale de l'Île Vancouver et Nitinat) ont été prélevés. Ces échantillons ont été recueillis dans des pêcheries expérimentales et commerciales. L'ouvrage présente les résultats concernant la composition des stocks.

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

INTRODUCTION

Genetic stock identification (GSI) has occurred in Canadian chum fisheries since 1981 (Beacham et al. 1985). GSI results provide fisheries staff with stock identification information needed to effectively manage commercial fisheries. In addition, this information provides estimates of harvest by country, which are used in implementing the terms of the Pacific Salmon Treaty.

For Canadian commercial fisheries, GSI results have provided information on migration routes and timing as well as assisted in stock abundance estimates. During the season, weekly results provide managers with an indication of chum run activity. After final analysis are complete, GSI results are used to estimate catch interceptions, which are required for stock assessment and Pacific Treaty obligations. This annual report includes a description of GSI sampling methods, analysis and results conducted in the 1992 chum fishing season.

METHOD

(A) Collection

In 1992, a total of 6,664 fish were sampled from three chum fishing areas in southern British Columbia. Sampling occurred from early September to early November. Chum were collected from two commercial gear types (gillnet and seine), and sampled from either 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 in 1992 from the following three fishing areas (Fig. 1): Johnstone Strait (Area 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. The minimum sample size was 150-200 chum.

(i) Johnstone Strait

The Johnstone Strait (Area 12) test fishery sampling program was conducted aboard two chartered seine vessels. Tissue samples were collected each week in conjunction with stock abundance testing at predetermined sites as described in Vreeling et al. (1987). Sampling commenced early in September and continued until early November. A total of 2,938 samples were collected from both vessels over a 9 week period. Each vessel collected approximately 150 chum samples per week.

In addition to the Johnstone Strait test fishery sampling, the Johnstone Strait commercial fisheries were sampled. Each commercial fishery was sampled at three landing sites for a total of 600 chum. The Johnstone Strait fishery occurred in both Statistical Areas 12 and 13. The number of fish collected from each Statistical area was based on the distribution of catch.

In 1992, three commercial fisheries occurred in Johnstone Strait. The first two fisheries occurred on September 22 and October 3. Each fishery sampled approximately 200 fish from three landing sites in Vancouver. Each sample contained a desired mixture of Areas 12 and 13 caught fish (approximately 60% and 40% respectively). The third commercial fishery occurred on October 21 when 599 chum were sampled. The preferred mixture between Area 12 and Area 13 was an equal combination, however due to sampling complications a 20% and 80% mixture was achieved.

A total of 4,724 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 two gillnet fisheries which occurred on October 13 and November 3. Three separate sub areas were sampled from the first gillnet fishery resulting in a sample size of 449. However, due to the availability of catch the second fishery only sampled two sub areas, for a total of 191 chum.

Harvesting continued until mid November by gillnet and seine. These terminal "clean up" fisheries commenced on November 9 for gillnets and November 18 for seines. These fisheries occurred near the primary Mid Vancouver Island spawning streams and were not sampled for GSI.

A total of 740 chum were sampled during early commercial fisheries in Mid Vancouver Island.

(iii) Nitinat

Commercial fisheries in the Nitinat area (Areas 21/121) commenced September 28. The fishery was restricted to gillnets during the first week, then to seines for two days on October 5-6. After these separate gillnet and seine fisheries, a combined gear fishery commenced on October 7. An expanded fishing area was provided for gillnets only during the combined gear fishery, which extended into Area 20-1 as far as Logan Creek (seaward to a point two miles south of Logan Creek). No specific GSI sampling was conducted in this area.

Samples of 200-400 fish per week were sampled from the commercial fisheries. Samples were collected from packers and/or seine vessels which delivered to processing plants in Vancouver. Samples generally represent the catch from 1-3 days prior to the sample date. The first two samples represent single gear fisheries, (first gillnet, then seine). Subsequent samples from the combined gear fishery may include catch from both gillnet and

seine; however, the vast majority of the catch (85%-95% per week) was caught by seine vessels.

Two samples of 200 each were taken during the third week of October (week 10/3) in response to an apparent influx of smaller, brighter fish on about October 13-14.

A total of 1200 samples were collected from Nitinat commercial fisheries.

(iv) Other Areas

Chum fisheries frequently occur in other discreet terminal areas. In 1992 terminal chum fishing occurred at Nimpkish (Area 12), 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 scheduled for these terminal chum fishing areas.

(B) Analysis

After collection, the frozen chum tissues 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. 1991: 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.

Information from each fishery is compared to a baseline grouping which includes all possible stock contributors to the fishery. For Johnstone Strait, Qualicum and Nanaimo fisheries, the baseline group used includes stocks originating from Johnstone Strait, Georgia Strait and Washington. For Nitinat fisheries the baseline used includes West Coast Vancouver Island, Georgia Strait and Washington stocks. The individual baseline stocks and respective allelic frequencies are detailed in Hop Wo et al. (1992). Selection of stocks comprising a baseline are determined from chum migration routes and stock abundance.

Stock compositions are derived from comparisons and analysis which employed the method described by Fournier et al. (1984). The results were estimated using the genotypic frequencies and allocation method outlined by Beacham et al. (1987). Method and procedures for analysis using a maximum likelihood computer model are outlined in McKinnell 1990. The standard deviations of the estimates were determined by boot strapping, where new samples were constructed by sampling the original mixture and baseline with replacement. Computer model parameters (convergence criteria) were set at $10 \, e^{-10}$ for point estimates and $10 \, e^{-7}$ for boot strapping. Standard deviation estimates were derived from a boot strapped learning sample.

Sampling and electrophoretic processing checks were conducted by duplication and submission of samples. The processing check consisted of collecting and submitting duplicate tissue samples from 100 chum. The duplicated samples were analyzed and the scores and results were then compared with each other.

RESULTS

The GSI (electrophoretic) stock composition results from four commercial fishery locations are presented in Tables 1 to 4.

The results of GSI analysis are expressed as percentages by major stock areas (Fraser River; Johnstone Strait/Strait of Georgia; United States; and West Coast Vancouver Island). Included with stock composition estimates are, week and area of collection, sample date and size, gear type sampled from, and estimates of standard deviation.

Results of the identical duplicate sample revealed 1.8% of the individual scores were different from the original scores (missing scores not included).

ACKNOWLEDGEMENTS

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Table 1. Combined weekly chum stock composition in Johnstone Strait (Area 12) seine test fishery, 1992 (1).

				Stock Composition (2)					
				% FR		% JS,GS		% US	
Week	Sample Date	Sample Size	Gear (3)	%	(1SD)	%	(1SD)	%	(1SD)
9/1	Sep 1–3	227	TS	54.3	(17.7)	45.6	(17.3)	0.0	(5.9)
9/2	Sep 8–10	300	TS	22.0	(12.7)	77.9	(12.4)	0.0	(1.2)
9/3	Sep 14–18	300	TS	62.4	(15.1)	35.2	(14.7)	2.3	(3.9)
9/4	Sep 23–27	302	TS	33.6	(13.7)	66.4	(13.8)	0.0	(7.8)
10/1	Sep 27–Oct 2	299	TS	7.0	(18.4)	86.9	(17.7)	6.1	(4.3)
10/2	Oct 7–9	300	TS	17.3	(14.6)	79.3	(13.2)	3.4	(5.6)
10/3	Oct 11–17	304	TS	14.5	(16.5)	77.5	(16.6)	8.0	(5.2)
10/4	Oct 19,20,23	305	TS	22.0	(17.1)	70.2	(15.8)	7.8	(9.4)
10/5	Oct 26–30	302	TS	12.3	(15.6)	72.3	(12.3)	15.4	(10.6)
11/1	Nov 2–4	299	TS	17.2	(14.0)	75.8	(14.4)	7.1	(4.5)

(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: TS = test seine.

Table 2. Weekly chum stock composition in Johnstone Strait (Areas 12 & 13) commercial
seine fisheries, 1992 (1).

| | | | | | Stock Composition (2) | | | | | |
| | | | | | % FR | | % JS,GS | | % US | |
Week	Sample Date	Sample Size	Area	Gear(3)	%	(1SD)	%	(1SD)	%	(1SD)
9/4	Sep 22	194	12–13	CSN	1.1	(14.5)	95.1	(15.1)	3.8	(5.9)
9/4	Sep 21–22	197	12–13	CSN	31.3	(18.2)	68.7	(18.1)	0.0	(0.4)
9/4	Sep 22	200	12–13	CSN	47.3	(14.0)	52.6	(13.5)	0.0	(2.5)
10/2	Oct 5	200	12–13	CSN	4.5	(9.7)	80.6	(10.2)	14.9	(7.6)
10/2	Oct 5	198	12–13	CSN	29.0	(17.7)	55.0	(16.5)	15.9	(12.3)
10/2	Oct 5	198	12–13	CSN	26.5	(15.8)	57.4	(16.1)	16.1	(7.4)
10/4	Oct 21	199	13	CSN	30.5	(16.8)	68.0	(14.2)	1.5	(9.5)
10/4	Oct 21	200	13	CSN	26.8	(17.8)	59.7	(15.7)	13.5	(9.2)
10/4	Oct 21	200	12–13	CSN	30.1	(14.2)	60.0	(13.7)	9.9	(4.9)
9/4	Sep 21–22	591	12–13	CSN	24.9	(11.8)	74.4	(11.6)	0.7	(0.9)
10/2	Oct 5	596	12–13	CSN	19.0	(12.2)	67.8	(11.8)	13.2	(6.8)
10/4	Oct 21	599	12–13	CSN	32.5	(11.8)	59.6	(10.9)	7.9	(4.2)

(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.

Table 3. Weekly chum stock composition in Mid Vancouver Island (Area 14) commercial fisheries, 1992 (1).

| Week | Sub–areas Sampled (3) | Sample Dates | Sample Size | Gear (4) | Stock Composition (2) | | | | | |
| | | | | | % FR | | % JS,GS | | % US | |
					%	(1SD)	%	(1SD)	%	(1SD)
10/3	14–(i)	Oct 13	150	CGN	34.1	(19.4)	61.9	(18.4)	4.0	(6.4)
10/3	14–(o)	Oct 13	150	CGN	17.9	(11.2)	78.0	(12.2)	4.1	(5.7)
10/3	14–(u)	Oct 13	149	CGN	0.0	(4.6)	99.9	(5.1)	0.0	(2.5)
11/1	14–(i)	Nov 03	150	CGN	2.2	(8.5)	88.0	(12.5)	9.8	(10.0)
11/1	14–(o)	Nov 03	141	CGN	4.3	(12.0)	86.6	(13.1)	9.1	(6.5)

(1) Stock composition from electrophoretic analysis of samples taken from the 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, eastern boundary (most fishing occurs in 14–5); 14–4,5(i) = inside, western boundary; 14–9,10(u) = upper northern boundary.

(4) Gear : CGN – commercial gillnet.

Table 4. Weekly chum stock composition in Nitinat (Area 21) commercial fisheries, 1992 (1).

Week	Sample Date	Sample Size	Gear (3)	% FR		% JS,GS		% US		% WCVI	
				%	(1SD)	%	(1SD)	%	(1SD)	%	(1SD)
10/1	Oct 3	200	CGN	0.0	(0.1)	0.0	(1.3)	10.9	(5.4)	89.1	(5.5)
10/2	Oct 7	200	CSN	0.0	(0.1)	11.0	(11.4)	4.6	(2.3)	84.4	(10.8)
10/3	Oct 13	200	CSN,CGN	4.5	(4.2)	1.9	(6.5)	5.9	(3.8)	87.6	(8.0)
10/3	Oct 16	200	CSN,CGN	12.8	(10.1)	2.9	(8.6)	4.6	(6.2)	79.6	(10.2)
10/4	Oct 22	200	CSN,CGN	8.5	(13.5)	17.5	(13.1)	0.1	(4.8)	73.8	(11.2)
10/5	Oct 29	200	CSN,CGN	12.9	(7.7)	2.8	(5.8)	0.9	(4.2)	83.4	(9.4)
10/3	Oct 13,16	400	CSN,CGN	3.4	(6.3)	2.0	(4.6)	5.0	(3.0)	89.6	(6.8)

(1) Stock composition from electrophoretic analysis of samples taken from commercial fisheries in Area 21 and a portion of Area 121. Samples collected at landing site. Point estimate (%) for week and standard deviation (1SD) from bootstrap simulation.

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

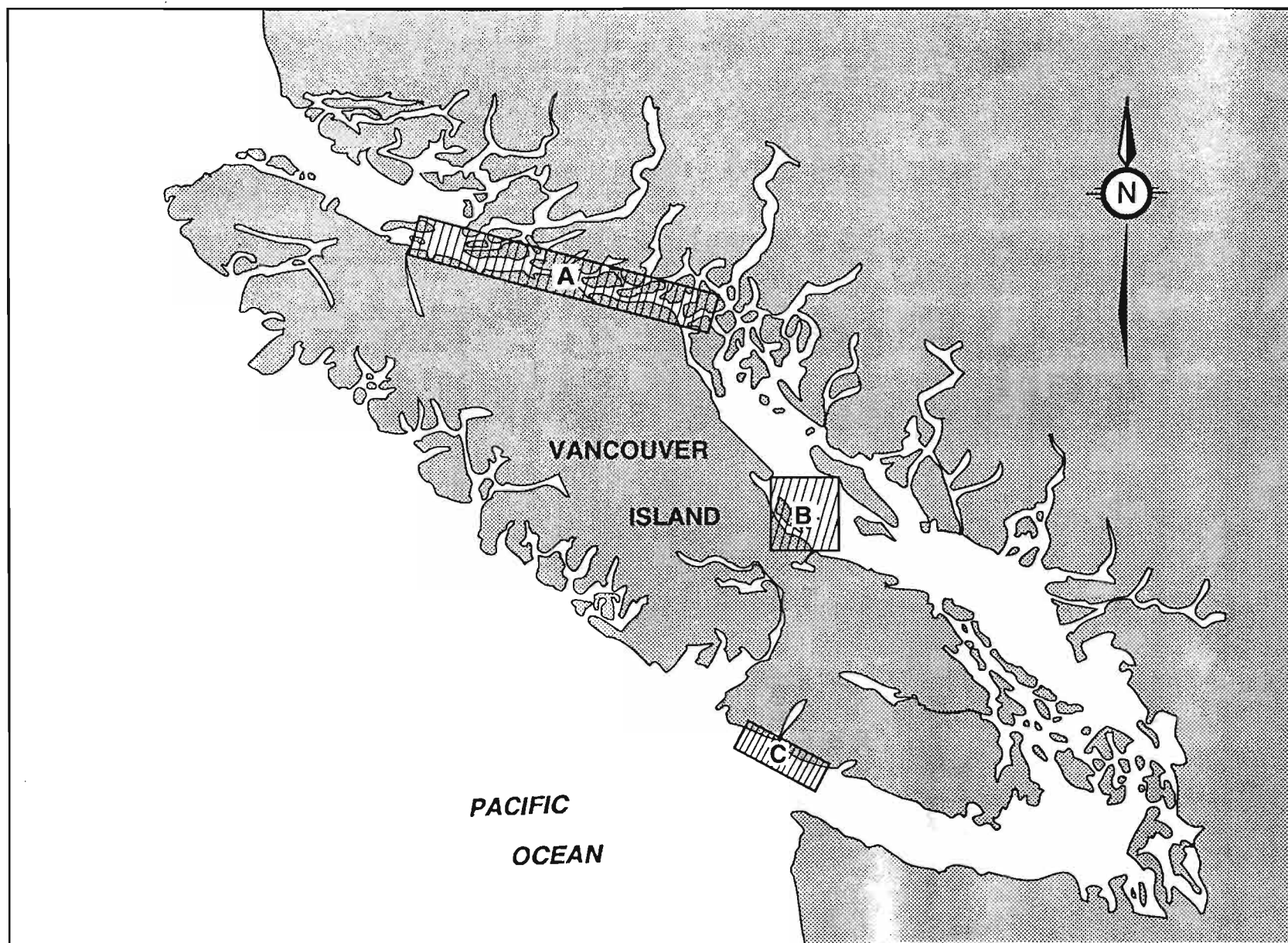(3) Gear: CGN – commercial gillnet; CSN – commercial seine.

Fig. 1. Regions of Chum Sampling in 1992.

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