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Canadian Highseas Salmon Surveys in the Fall of 2003 and the Winter of 2004: Seasonal Changes in the Distributions of Juvenile Salmon on the Continental Shelf off British Columbia and Southeast Alaska

by

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ABSTRACT

Morris, J. F.T., M. Trudel, D.W. Welch, M. E. Thiess, T. B. Zubkowski, and H R.C. MacLean. 2004. Canadian Highseas Salmon Surveys in the Fall of 2003 and the Winter of 2004: Seasonal Changes in the Distributions of Juvenile Salmon on the Continental Shelf off British Columbia and Southeast Alaska. (NPAFC Doc. 780), 28 p.

The Canadian Highseas Salmon Program conducted two surveys from October 8-27, 2003 and from February 13-28, 2004 on the *CCGS W.E. Ricker* to compare distributions, abundances, and the biology of juvenile salmon off British Columbia and Southeast Alaska between the fall and the winter.

The distributions of juvenile salmon determined on these two surveys were consistent with all the Highseas Salmon fall and winter surveys conducted since the year 2000. All these surveys demonstrated that almost all the juvenile pink, chum, and sockeye salmon migrated off the shelf of British Columbia and Southeast Alaska, and from the inside straits of Southeast Alaska sometime between the beginning of November and mid-February. The surveys also demonstrated that all juvenile coho migrated from the inside straits of Southeast Alaska sometime between the beginning of November and mid-February. In contrast, juvenile coho were still on the shelf and within the inlets on the west coast of Vancouver Island both in the fall and winter. Juvenile chinook under 300 mm in fork length were distributed coast-wide from Vancouver Island to Southeast Alaska in both the fall and winter. Juvenile chinook from 100 to 199 mm in fork length resided in the inlets on the west coast of Vancouver Island in the fall. These were determined to be age 0.0, ocean ecotypes based on CWT recoveries.

INTRODUCTION

The Highseas Salmon Program of Fisheries and Oceans Canada has conducted annual Pacific salmon surveys in the Gulf of Alaska since 1995[1-21]. The main objectives of these surveys were to determine the effects of ocean conditions and climate change on the growth, survival, and migration of juvenile salmon. To achieve these objectives, information was collected on (1) the distribution and ecology of Pacific salmon (*Oncorhynchus spp.*) during their ocean phase, (2) the ambient oceanographic conditions, and (3) the distribution and biomass of zooplankton. The data collected during these surveys have been published in data reports[1-21] and are available through the High Seas Salmon Program.

From 1998 to 2000, surveys were typically conducted in the spring and summer to describe the ocean conditions during the growing season, and in the fall to determine the size and energetic status of juvenile salmon at the end of the growing season. Since 2001, the Highseas Salmon Program added a survey in February-March to assess the distribution, migration, and physiological condition of juvenile salmon at the end of winter. Due to the low productivity and cold temperatures that prevail during winter, it is generally believed that this season represents a critical period for juvenile salmon[22-23], as well as for the early stages of many freshwater[24] and marine fishes[25-26]. Yet, few studies have been conducted on juvenile salmon during the winter in the marine environment.

Here, we present the results of two surveys conducted by the Highseas Salmon Program from October 8-27, 2003 and from February 13-28, 2004 on the *CCGS W.E. Ricker*. This report compares distributions, abundances, and the biology of juvenile salmon off British Columbia and Southeast Alaska between the fall and the winter. We hope that this preliminary report will stimulate further research on the ocean ecology of salmon during winter throughout the North Pacific Ocean.

MATERIALS AND METHODS

General Survey Information

Figures 1-4 show the fishing and oceanographic stations completed by the *CCGS W.E. Ricker* on the October 8-27, 2003 and February 13-28, 2004 surveys. Survey design and coverage were similar. On both surveys, fishing and oceanographic operations were conducted off the west coast of Vancouver Island, in Queen Charlotte Sound, in Dixon Entrance, along the inside channels of Southeast Alaska, and on the shelf off Southeast Alaska. In addition, on both surveys, two cross-shelf oceanographic transects that extended approximately 120 nautical miles offshore were completed near Triangle Island at the northern tip of Vancouver Island and Forrester Island, Southeast Alaska. On the fall, 2003 survey, scientific operations were also conducted on the central coast of British Columbia.

Fishing Gear and Fishing Operations

The Highseas Salmon Program conducted the surveys on the *CCGS W.E. Ricker*, a stern trawler 58 m in length that is powered by a 2,500 H.P. model AH 40 Akasaka diesel engine.

The *CCGS W.E. Ricker* towed a model 240 mid-water trawl. The trawl has a heavy-duty front end of hexagonal web made from 3/8 in. (9.5 mm) and 5/16 in. (7.9 mm) Tenex rope, and a tapered body made-up of 64 in. (163 cm), 32 in. (81.3 cm), 16 in. (40.6 cm), 8 in. (20.3 cm) and 4 in. (10.2 cm) polypropylene sections, an intermediate section of 3 in. (7.6 cm) polypropylene, and a codend of 1.5 in. (3.8 cm) knotted nylon lined with 0.25 in. mesh (64 mm). The trawl has three 40 m bridles of 5/8 in. (1.6 cm) wire rope per side that are attached with a single hook-up to 5 m Jet doors. Typically, 100-150 m of 1.25 in. (3.2 cm) warp was paid out to tow the trawl at the surface.

The *CCGS W.E. Ricker* was able to tow the trawl at the surface at around 5 knots (2.6 m s^{-1}) in good sea conditions, and this typically achieved a mouth opening of approximately 28 m wide by 16 m deep. In most cases, the trawl was towed for 30 minutes. However, to prevent excessive catches, tow duration was occasionally reduced to 15 minutes. To standardize catches for variable sampling effort and tow speed (range: 3-7 knots or 1.5-3.6 m s^{-1}), the catch was divided by the swept volume and expressed as the number of fish per one cubic hectameter ($Hm^3 = 10^6\ m^3$), The swept volume was estimated by multiplying the distance covered (i.e. speed multiplied by tow duration) by the mouth opening of the net.

Oceanographic Sampling

At oceanographic stations, the scientific crew (1) conducted CTD (conductivity-temperature-depth) casts to 250 m with a Seabird SBE 911+ probe, (2) collected surface seawater samples with a Niskin bottle for nitrate, phosphate, silicate, and salinity, and (3) filtered surface seawater on GF/F glass fibre filter disks for chlorophyll.

Detailed information on the CTD casts and water sampling for the fall, 2003 survey has been previously reported[19]. Detailed information on the CTD casts and water sampling for the winter, 2004 survey will be published in 2005 in a Canadian Data Report of Fisheries and Aquatic Sciences.

The CTD files from both the fall, 2003 and the winter, 2004 surveys are catalogued on the website of the Canadian Department of Fisheries and Oceans, Ocean Science and Productivity division (OSAP) at:

http://www-sci.pac.dfo-mpo.gc.ca/osap/data/default_e.htm

Contact Joe Linguanti at linguantij@pac.dfo-mpo.gc.ca for permission to access these data.

Zooplankton Sampling

At oceanographic stations, the scientific crew also conducted vertical tows for plankton to150 m with bongo gear fitted with twin 57" diameter, 253 μm Nitex nets.

Detailed information on the plankton tows for the fall, 2003 survey has been previously reported [19] . Detailed information on the plankton tows for the winter, 2004

survey will be published in 2005 in a Canadian Data Report of Fisheries and Aquatic Sciences.

The zooplankton sampling details, and any associated species identification and enumeration analyses from both the fall, 2003 and the winter, 2004 surveys are archived in the Fisheries and Oceans Canada, Pacific Region Zooplankton database at:

http://www-sci.pac.dfo-mpo.gc.ca/osap/projects/plankton/zooplanktondatabase_e.htm

Contact Steve Romaine at romaines@pac.dfo-mpo.gc.ca for permission to access these data.

RESULTS AND DISCUSSION

Salmon Catch Data

Tables 1 and 2 report information on trawl tows and a summary of Pacific salmon catches for theses surveys. For each tow, catch totals are provided for all chinook salmon (*O. tshawytscha*) ("CK") that includes all ages and size classes, and separately for juveniles and adults of chum salmon (*O. keta*) ("CM"), coho salmon (*O. kisutch*) ("CO"), pink salmon (*O. gorbuscha*) ("PK"), and sockeye salmon (*O. nerka*) ("SE").

On the fall, 2003 survey, juvenile pink, chum, sockeye, and coho were defined as salmon in their first fall in the ocean (age X.0), while adults included all older age groups (age X.1 or older). Age separation was determined based on examination of fork length distributions which showed non-overlapping size modes. Chinook salmon were not divided into juveniles and adults based on fork length distributions since there is considerable overlap among size modes that represent the multiple age groups. Instead, juvenile chinook were arbitrarily defined in this report to be under 300 mm in fork length.

On the winter, 2004 survey, juvenile pink, chum, sockeye, and coho were defined as salmon in their first winter in the ocean (age X.1), while adults included all older age groups (age X.2 or older). Again, juvenile chinook were arbitrarily defined to be under 300 mm in fork length.

The abbreviations for the regions in Tables 1 and 2, and in Figures 21-25 are:

ISEA	Inside straits of Southeast Alaska
SEA	offshore Southeast Alaska
DE	Dixon Entrance
HS	Hecate Strait
IBC	Inside channels on the central coast of British Columbia
QCSD	Queen Charlotte Sound
VI	west coast of Vancouver Island
IVI	Inlets on the west coast of Vancouver Island

Catch Distributions: fall surveys

On the fall, 2003 survey, juvenile pink (age 0.0) and juvenile chum (age 0.0) were consistently caught within the range of 1-625 fish per Hm^3, and juvenile sockeye (age X.0) were consistently caught within the range of 1-125 fish / Hm^3 on the shelf from the northern tip of Vancouver Island to the inside straits of Southeast Alaska (Figures 5, 7,

and 9). Juvenile pink, chum, and sockeye catches were scattered and very low (1-5 fish per Hm^3) off the west coast of Vancouver Island. Juvenile coho (age X.0) were caught within the range of 1-625 fish / Hm^3 on the shelf from the west coast of Vancouver Island to Southeast Alaska, along the inside passages on the central coast of British Columbia, and within the inside straits of Southeast Alaska (Figure 11), which was consistent with the 2000, 2001, and 2002, fall surveys[11,13, and 15]. Juvenile chinook from 100 to 199 mm in fork length were caught within the range of 1-125 fish / Hm^3 primarily in southern regions including the shelf and inlets on the west coast of Vancouver Island and in Fitz Hugh Sound (Figure 13), which was consistent with the 2000, 2001, and 2002 fall surveys[11,13, and 15]. All the juvenile chinook from 100 to 199 mm in fork length with CWT's were age 0.0, ocean-ecotypes that had been released in the spring from local hatcheries.

Catch Distributions: winter surveys

The Highseas Salmon surveys in the fall and winter since 2000[11,13,14,15,16,17 and 19] have shown that almost all the juvenile pink, chum, and sockeye migrate from the shelf off British Columbia and Southeast Alaska, and the inside straits of Southeast Alaska sometime between the beginning of November and mid-February.

On the winter 2004 survey, no juvenile pink (age 0.1) or chum (age 0.1) were caught in Dixon Entrance and Southeast Alaska. No juvenile sockeye were caught in Dixon Entrance and only 2 juvenile sockeye (age X.1) were caught in Southeast Alaska (Figures 6, 8, and 10). No juvenile pink were caught off the west coast of Vancouver Island, and juvenile chum and sockeye catches were remained scattered and low (1-5 fish / Hm^3) in this area. In general, these distributions were consistent with the winter surveys in 2001, 2002, and 2003[14,16, and 7]. However, the winter 2003 survey was exceptional in that high numbers of juvenile pink, chum, and sockeye were caught on three tows in McIntyre Bay in Dixon Entrance. Almost all the juvenile sockeye caught there were either Fraser River or central coast stocks based on DNA stock identification methods (J. Candy, Fisheries & Oceans Canada, Nanaimo, *personal communication*).

The relatively large abundance of juvenile pink, chum, and sockeye salmon in February 2003 was highly unusual, as these fish are generally expected to quickly migrate northward and reach the Aleutians late in the fall before leaving the continental shelf for the open waters of the Gulf of Alaska[27-28]. This may be due to the mild El Niño that occurred late in 2002 and early in 2003. However, the time series is only 4 years and is too short to allow definitive conclusions regarding this anomalous distribution. Sampling that will be conducted by the Highseas Salmon Program during February and March 2005 may help to test this hypothesis, as an El Niño has been forecasted for the end of December 2004 and following months[29].

The Highseas Salmon surveys in the fall and winter since 2001 have also shown that almost all juvenile coho migrate from the shelf off Southeast Alaska, and the inside straits of Southeast Alaska sometime between the beginning of November and mid-February, as not a single juvenile coho has been caught in Southeast Alaska on four consecutive winter surveys[11,13,14,15,16,17 and 19]. On the winter 2004 survey, just one juvenile coho (age X.1) was caught off Clayoquot Sound off the west coast of Vancouver Island, but juvenile coho were caught within the range of 1-125 fish / Hm^3 on

three tows in Quatsino Sound (Figure 12), which was generally consistent with the 2001, 2002, and 2003 winter surveys [14,16, and 17].

On both the fall, 2003 and the winter, 2004 surveys , juvenile Chinook from 200 to 299 mm in fork length were caught within the range of 1-125 fish / Hm^3 tow on the shelf and inlets on the west coast of Vancouver Island, and in the straits of Southeast Alaska (Figure 15 and 16), which was consistent with all the previous fall and winter surveys since 2000 [11,13,14,15,16, and 17]. Although the age of these fish has not been assessed directly, previous studies suggest that juvenile Chinook of this size are most likely age 1.0 stream ecotypes[30].

Regional Size Comparisons of Juvenile Salmon

Juvenile pink (age 0.0) increased significantly in size from south to north on the fall, 2003 survey ($F= 44.5$, $p<0.001$) (Figure 19). Juvenile pink averaged 202 mm in fork length off the west coast of Vancouver Island , 205 mm in Hecate Strait, 209 mm in the inside passages on the central coast of British Columbia, 206 mm in Dixon Entrance, and 224 mm inside Southeast Alaska.

Juvenile chum (age 0.0) increased significantly in size from south to north on the fall, 2003 survey ($F = 24.37$, $p<0.001$) (Figure 20). Juvenile chum averaged 216 mm in Queen Charlotte Sound, 224 mm in Hecate Strait, 242 mm in the inside passages on the central coast of British Columbia, 227 mm in Dixon Entrance, and 233 mm on the shelf off Southeast Alaska.

Juvenile sockeye (age X.0) increased significantly in size from south to north on the fall, 2003 survey ($F = 31.77$, $p<0.001$) (Figure 21). Juvenile sockeye averaged 185 mm in Hecate Strait, 209 mm in the inside passages on the central coast of British Columbia, and 211 mm inside Southeast Alaska.

Juvenile coho (age X.0) increased significantly in size from south to north on the fall, 2003 survey ($F =21.1$, $p<0.001$) (Figure 22). Juvenile coho averaged 268 mm in the inlets on the west coast of Vancouver Island, 284 mm on the shelf off the west coast of Vancouver Island , 300 mm in the inside passages on the central coast of British Columbia, 294 mm in Dixon Entrance, 302 mm inside Southeast Alaska, and 318 mm on the shelf off Southeast Alaska.

It was not possible to make regional or seasonal comparisons of sizes of juvenile chinook for specific ocean age classes due to the considerable overlap among size modes that represent multiple age groups.

The increase in size of juvenile pink, chum, sockeye, and coho from the west coast of Vancouver Island to Southeast Alaska may reflect either better feeding conditions in the north or an earlier northward migration of larger fish from southern areas. In addition, for coho and sockeye, this may reflect different size at ocean entry, as northern fish tend to spend more years in freshwater before migrating to sea.

Seasonal Size Comparisons of Juvenile Salmon

Juvenile coho increased significantly in size in the inlets on the west coast of Vancouver Island over the winter ($F=59.6$, $p<0.001$) (Figure 22). Juvenile coho averaged 264 mm and 308 mm in the fall and winter, respectively. These size differences may occur due to size-selective mortality[22-23] or to growth. Further analyses will be performed to determine the extent of size-selective mortality in juvenile coho

salmon off the west coast of Vancouver Island, lipid utilization, and stock composition and migration over the winter period.

Suggestions for future work

Winter is generally believed to be a critical period for many aquatic and terrestrial organisms, including Pacific salmon. Yet, most research on the ocean ecology of salmon has been conducted in the spring, summer and fall, with little effort being directed at sampling juvenile salmon during winter. The data collected in this study can serve as a baseline for assessing changes in distribution and size of juvenile salmon over the winter in other regions of the North Pacific and under different ocean and climate conditions such as El Niño events. Additional annual internationally coordinated winter survey programs targeting juvenile salmon throughout their distribution around the Pacific rim will be necessary to enhance our understanding of the effects of ocean conditions on the marine distribution, migration, physiological condition, bioenergetics, growth, and survival of Pacific salmon.

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Table 1. Tow positions and catch summaries of Pacific salmon for the CCGS W.E. RICKER survey to the Gulf of Alaska, 08/10/2003 - 27/10/2003.

Station ID	Station Name	Region	Date	Time	Latitude (°N)	Longitude (°W)	Heading (°T)	SOG (kts)	Bottom Depth (m)	CK all	CM Juv	CM ad.	CO Juv	CO Ad.	PK Juv	PK Ad.	SE Juv	SE Ad.
HS200336IVI01	TREVOR CH	IVI	09-Oct-03	10:39	48.865	125.121	48	5.54	131	1	0	2	1	0	0	0	0	0
HS200336IVI02	TREVOR CH	IVI	09-Oct-03	12:34	48.917	125.048	31	5.33	153	16	0	2	0	0	0	0	0	0
HS200336IVI03	IMPERIAL EAGLE CH	IVI	09-Oct-03	14:21	48.954	125.114	230	5.38	88	4	0	3	0	0	0	0	0	0
HS200336IVI04	IMPERIAL EAGLE CH	IVI	09-Oct-03	15:56	48.924	125.198	218	5.3	94	0	0	0	1	2	2	0	0	0
HS200336IVI05	IMPERIAL EAGLE CH	IVI	09-Oct-03	17:21	48.860	125.251	205	5.29	90	4	0	5	0	2	5	0	0	0
HS200336IVI06	HECATE CH	IVI	10-Oct-03	08:22	49.862	126.744	309	5.56	250	16	1	2	1	1	5	0	0	0
HS200336IVI07	ZEBALLOS INLET	IVI	10-Oct-03	10:50	49.893	126.783	342	5.18	159	8	0	9	1	1	2	0	0	0
HS200336IVI08	ESPERANZA INLET	IVI	10-Oct-03	12:47	49.869	126.844	253	5.82	231	5	0	6	0	0	0	0	0	0
HS200336IVI09	ESPERANZA INLET	IVI	10-Oct-03	14:18	49.856	126.929	245	5.46	240	76	0	16	2	1	0	0	0	0
HS200336VI01	OFF ESPERANZA	VI	10-Oct-03	15:50	49.787	127.083	263	5.23	45	23	0	3	14	0	0	0	0	0
HS200336VI02	OFF ESPERANZA	VI	10-Oct-03	17:04	49.787	127.208	274	5.83	35	1	0	2	34	1	0	0	0	0
HS200336IVI10	TAHSISH INLET	IVI	11-Oct-03	07:55	50.103	127.123	235	5.9	165	6	0	19	0	2	0	0	1	0
HS200336IVI11	KASHUTL INLET	IVI	11-Oct-03	09:42	50.086	127.252	178	5.53	184	4	0	2	1	0	0	0	0	0
HS200336IVI12	KYUQUOT CH	IVI	11-Oct-03	11:11	50.044	127.253	111	4.71	254	1	0	8	1	0	0	0	0	0
HS200336IVI13	KYUQUOT CH	IVI	11-Oct-03	12:49	50.011	127.174	241	5.21	110	0	0	9	1	1	0	0	0	0
HS200336IVI14	KYUQUOT CH	IVI	11-Oct-03	13:54	49.979	127.249	57	5.78	144	5	0	4	2	0	0	0	0	0
HS200336IVI15	QUATSINO SD	IVI	12-Oct-03	15:35	50.469	127.937	83	5.31	210	2	0	2	8	0	0	0	0	0
HS200336IVI16	QUATSINO SD	IVI	12-Oct-03	16:57	50.483	127.849	82	5.09	172	2	0	1	11	0	0	0	0	0
HS200336IVI17	QUATSINO SD	IVI	12-Oct-03	18:22	50.493	127.768	72	5.4	126	13	0	6	2	0	0	0	0	0
HS200336IVI18	NEROUTSOS INLET	IVI	13-Oct-03	07:34	50.408	127.494	334	5.86	134	35	1	1	0	0	0	0	0	0
HS200336IVI19	NEROUTSOS INLET	IVI	13-Oct-03	09:35	50.446	127.525	329	5.33	186	10	1	0	2	0	0	0	0	0
HS200336IVI20	QUATSINO SD	IVI	13-Oct-03	11:21	50.496	127.706	264	5.68	112	5	0	2	7	0	0	0	0	0
HS200336VI04	OFF QUATSINO	VI	13-Oct-03	13:57	50.416	128.002	246	5.28	169	1	0	0	10	0	0	0	0	0
HS200336VI05	OFF QUATSINO	VI	13-Oct-03	15:14	50.405	128.102	302	5.42	72	0	1	1	9	0	0	0	0	0
HS200336VI06	OFF QUATSINO	VI	13-Oct-03	16:28	50.439	128.194	308	4.86	97	1	0	0	16	0	0	0	0	0
HS200336VI07	OFF QUATSINO	VI	13-Oct-03	18:12	50.473	128.297	322	5.05	120	0	0	0	6	0	0	0	0	0
HS200336IBC01	FITZ HUGH SD	IBC	15-Oct-03	14:25	51.723	127.925	352	5.45	330	0	30	0	2	0	16	0	0	0
HS200336IBC02	FITZ HUGH SD	IBC	15-Oct-03	16:33	51.832	127.933	0	5.28	307	5	42	0	7	0	15	0	4	0
HS200336IBC03	FITZ HUGH SD	IBC	15-Oct-03	18:41	51.924	127.946	189	5.95	344	120	0	0	224	0	1	0	1	0
HS200336IBC04	PRINCIPE CH	IBC	16-Oct-03	10:56	53.441	129.951	314	5.87	254	0	0	0	0	0	10	0	1	0

Table 1. Tow positions and catch summaries of Pacific salmon for the CCGS W.E. RICKER survey to the Gulf of Alaska, 08/10/2003 - 27/10/2003.

Station ID	Station Name	Region	Date	Time	Latitude (°N)	Longitude (°W)	Heading (°T)	SOG (kts)	Bottom Depth (m)	CK all	CM Juv	CM ad.	CO Juv	CO Ad.	PK Juv	PK Ad.	SE Juv	SE Ad.
HS200336IBC05	OGDEN CH	IBC	16-Oct-03	15:08	53.858	130.306	28	5.3	194	0	0	0	3	0	3	0	0	0
HS200336DE01	MCINTYRE B	DE	17-Oct-03	07:38	54.171	131.850	262	5.39	65	0	8	0	16	0	465	0	2	0
HS200336DE02	MCINTYRE B	DE	17-Oct-03	09:11	54.165	132.006	271	5.2	70	0	4	0	1	0	82	0	0	0
HS200336DE03	MCINTYRE B	DE	17-Oct-03	10:42	54.152	132.212	274	5.29	56	0	0	0	1	0	55	0	0	0
HS200336DE04	CAPE EPENSAW-DE	DE	17-Oct-03	12:29	54.164	132.436	283	5.85	78	0	7	0	0	0	117	0	1	0
HS200336DE05	KLASHWUN PT-DE	DE	17-Oct-03	14:00	54.181	132.583	273	4.64	92	0	1	0	8	0	30	0	1	0
HS200336DE06	NANKIVELL PT-DE	DE	17-Oct-03	15:32	54.178	132.736	275	4.09	56	0	1	0	10	0	5	0	0	0
HS200336DE07	SEATH PT-DE	DE	17-Oct-03	17:24	54.184	132.850	322	5.34	72	0	0	0	1	0	1	0	0	0
HS200336DE08	LANGARA I-DE	DE	17-Oct-03	18:20	54.238	132.918	322	4.65	147	0	0	0	0	0	0	0	0	0
HS200336FI01	FORRESTER IS	SEA	18-Oct-03	07:53	54.794	133.052	267	4.44	123	1	0	0	10	0	1	0	0	0
HS200336FI02	FORRESTER IS	SEA	18-Oct-03	09:36	54.781	133.197	251	4.7	194	0	0	0	0	0	1	0	0	0
HS200336FI03	FORRESTER IS	SEA	18-Oct-03	11:04	54.763	133.340	241	4.98	126	0	0	0	5	0	0	0	0	0
HS200336FI05	FORRESTER IS	SEA	18-Oct-03	13:22	54.740	133.588	263	4.89	191	0	0	0	9	0	0	0	0	0
HS200336FI06	FORRESTER IS	SEA	18-Oct-03	15:12	54.724	133.722	263	4.82	192	0	0	0	0	0	0	0	0	0
HS200336FI07	FORRESTER IS	SEA	18-Oct-03	16:52	54.711	133.854	205	3.98	222	0	0	0	0	0	0	0	0	0
HS200336FI08	FORRESTER IS	SEA	18-Oct-03	18:41	54.705	133.976	273	5.04	201	0	0	0	0	0	0	0	0	0
HS200336ISEA01	SUMNER ST	ISEA	19-Oct-03	08:50	55.898	134.026	25	5.84	245	0	0	0	0	0	18	0	0	0
HS200336ISEA02	SUMNER ST	ISEA	19-Oct-03	10:31	55.994	133.958	25	4.36	162	0	0	0	1	0	0	0	0	0
HS200336ISEA03	SUMNER ST	ISEA	19-Oct-03	12:23	56.059	133.902	38	4.39	131	0	0	0	0	0	0	0	0	0
HS200336ISEA04	SUMNER ST	ISEA	19-Oct-03	14:28	56.159	133.726	347	5.55	268	3	0	0	0	0	0	0	0	0
HS200336ISEA05	SUMNER ST	ISEA	19-Oct-03	16:26	56.283	133.797	2	5.05	303	2	0	0	0	0	0	0	0	0
HS200336ISEA06	SUMNER ST	ISEA	19-Oct-03	18:43	56.378	133.582	96	4.28	376	2	0	0	0	0	0	0	0	0
HS200336ISEA07	SUMNER ST	ISEA	20-Oct-03	07:42	56.364	133.406	96	5.36	385	8	0	0	0	0	0	0	0	0
HS200336ISEA08	SUMNER ST	ISEA	20-Oct-03	10:23	56.462	133.017	66	4.95	140	6	1	0	7	0	16	0	3	0
HS200336ISEA09	STIKINE ST	ISEA	20-Oct-03	11:22	56.486	132.891	98	4.29	127	0	0	0	1	0	4	0	2	0
HS200336ISEA10	STIKINE ST	ISEA	20-Oct-03	14:07	56.440	132.643	98	4.55	163	2	0	1	1	0	2	0	0	0
HS200336ISEA11	STIKINE ST	ISEA	20-Oct-03	15:40	56.405	132.581	189	3.89	270	1	3	0	1	0	14	0	4	0
HS200336ISEA12	STIKINE ST	ISEA	20-Oct-03	17:59	56.320	132.605	210	4.67	308	2	3	0	2	0	8	0	1	0
HS200336ISEA13	CLARENCE ST	ISEA	21-Oct-03	07:15	56.027	132.713	145	3.65	354	11	1	0	0	0	0	0	0	0
HS200336ISEA14	CLARENCE ST	ISEA	21-Oct-03	08:33	55.976	132.612	134	3.28	331	2	0	0	0	0	0	0	0	0

Table 1. Tow positions and catch summaries of Pacific salmon for the CCGS W.E. RICKER survey to the Gulf of Alaska, 08/10/2003 - 27/10/2003.

Station ID	Station Name	Region	Date	Time	Latitude (°N)	Longitude (°W)	Heading (°T)	SOG (kts)	Bottom Depth (m)	CK all	CM Juv	CM ad.	CO Juv	CO Ad.	PK Juv	PK Ad.	SE Juv	SE Ad.
HS200336ISEA15	CLARENCE ST	ISEA	21-Oct-03	10:05	55.913	132.493	150	3.06	457	3	6	0	2	0	35	0	3	0
HS200336ISEA16	CLARENCE ST	ISEA	21-Oct-03	14:05	55.694	132.293	333	7.01	596	0	9	0	0	0	6	0	0	0
HS200336ISEA17	CLARENCE ST	ISEA	21-Oct-03	14:59	55.778	132.372	331	6.17	594	0	3	0	0	0	14	0	2	0
HS200336ISEA18	CLARENCE ST	ISEA	21-Oct-03	15:49	55.856	132.451	329	7.01	436	0	0	0	3	0	28	0	2	0
HS200336ISEA19	CLARENCE ST	ISEA	21-Oct-03	18:35	55.811	132.428	151	3.96	570	0	10	0	1	0	32	0	0	0
HS200336ISEA20	CLARENCE ST	ISEA	22-Oct-03	07:47	55.172	131.873	176	4.45	455	0	1	0	0	0	7	0	1	0
HS200336ISEA21	CLARENCE ST	ISEA	22-Oct-03	09:49	55.061	131.941	185	4.82	576	0	1	0	1	0	5	0	2	0
HS200336ISEA22	CLARENCE ST	ISEA	22-Oct-03	12:30	54.805	131.914	182	5.89	420	0	1	0	1	0	0	0	0	0
HS200336ISEA23	CLARENCE ST	ISEA	22-Oct-03	14:36	54.624	132.082	279	6.19	160	0	0	0	0	0	4	0	0	0
HS200336ISEA24	CAPE CHACON-DE	ISEA	22-Oct-03	16:11	54.652	132.268	288	5.54	122	0	2	0	0	0	11	0	3	0
HS200336ISEA25	PT MARSH-DE	ISEA	22-Oct-03	18:11	54.664	132.498	254	5.14	193	0	5	0	33	0	66	0	5	0
HS200336HS01	BROWNING E	HS	23-Oct-03	07:28	53.860	130.965	130	4.83	88	0	150	0	0	0	370	0	72	0
HS200336HS02	BROWNING E	HS	23-Oct-03	09:18	53.790	130.789	108	4.56	146	0	8	0	0	0	14	0	2	0
HS200336HS03	BROWNING E	HS	23-Oct-03	11:00	53.740	130.604	124	4.72	96	0	4	0	0	0	7	0	1	0
HS200336IBC06	PRINCIPE CH	IBC	23-Oct-03	12:50	53.659	130.447	123	4.23	136	0	1	0	0	0	1	0	0	0
HS200336IBC07	PRINCIPE CH	IBC	23-Oct-03	16:22	53.449	129.968	138	5.2	319	1	7	0	1	0	20	0	1	0
HS200336IBC08	PRINCIPE CH	IBC	23-Oct-03	18:17	53.350	129.799	128	5.89	178	2	15	0	6	0	7	0	4	0
HS200336IBC09	WHALE CH	IBC	24-Oct-03	07:40	53.108	129.114	358	5.65	506	3	0	0	16	0	0	0	0	0
HS200336IBC10	WHALE CH	IBC	24-Oct-03	09:51	53.245	129.098	351	4.74	475	0	0	0	0	0	0	0	0	0
HS200336IBC11	WRIGHT SD	IBC	24-Oct-03	12:10	53.343	129.207	275	6.04	505	3	10	0	5	0	53	0	26	0
HS200336IBC12	SQUALLY CH	IBC	24-Oct-03	14:32	53.247	129.439	170	5.37	477	0	7	0	0	0	21	1	5	0
HS200336IBC13	SQUALLY CH	IBC	24-Oct-03	16:23	53.137	129.387	154	4.55	537	0	1	0	0	0	2	0	0	0
HS200336IBC14	CAMPANIA SD	IBC	24-Oct-03	18:26	53.004	129.260	183	4.33	367	3	2	1	19	0	0	0	0	0
HS200336IBC15	ESTEVAN SD	IBC	25-Oct-03	07:40	53.168	129.633	150	4.44	164	2	14	0	0	0	6	0	0	0
HS200336IBC16	ESTEVAN SD	IBC	25-Oct-03	09:27	53.079	129.539	137	3.1	150	0	13	0	1	0	15	0	0	0
HS200336IBC17	CAMANO SD	IBC	25-Oct-03	12:22	52.935	129.382	126	5.1	219	0	3	0	0	0	11	0	0	0
HS200336IBC18	LAREDO CH	IBC	25-Oct-03	13:59	52.874	129.253	146	5.39	232	0	25	0	0	0	14	0	0	0
HS200336IBC19	LAREDO CH	IBC	25-Oct-03	15:53	52.768	129.127	139	4.96	218	0	44	0	0	0	19	0	3	0
HS200336T01	TRIANGLE IS	QCSD	26-Oct-03	07:33	51.271	128.340	245	4.49	88	0	48	0	1	0	3	0	11	0
HS200336T02	TRIANGLE IS	QCSD	26-Oct-03	09:29	51.204	128.468	239	4.72	204	0	1	0	0	0	0	0	1	0

Table 1. Tow positions and catch summaries of Pacific salmon for the CCGS W.E. RICKER survey to the Gulf of Alaska, 08/10/2003 - 27/10/2003.

Station ID	Station Name	Region	Date	Time	Latitude (°N)	Longitude (°W)	Heading (°T)	SOG (kts)	Bottom Depth (m)	CK all	CM Juv	CM ad.	CO Juv	CO Ad.	PK Juv	PK Ad.	SE Juv	SE Ad.
HS200336T03	TRIANGLE IS	QCSD	26-Oct-03	11:11	51.137	128.595	236	4.66	150	0	0	0	0	0	0	0	0	0
HS200336T04	TRIANGLE IS	QCSD	26-Oct-03	12:53	51.053	128.741	230	5.56	77	0	0	0	0	0	1	0	0	0
HS200336T05	TRIANGLE IS	QCSD	26-Oct-03	14:21	50.988	128.885	228	5.97	78	0	2	0	1	0	1	0	0	0
HS200336T06	TRIANGLE IS	QCSD	26-Oct-03	15:43	50.920	129.020	263	5.65	96	0	0	0	0	0	0	0	0	0
HS200336T07	TRIANGLE IS	VI	26-Oct-03	18:05	50.809	129.238	241	4.43	126	0	0	0	0	0	0	0	0	0
									Totals	421	498	107	531	11	1651	1	165	0
															Overall total		3385	

Table 2. Tow positions and catch summaries of Pacific salmon for the CCGS W.E. RICKER survey to the Gulf of Alaska, 13/02/2004 - 28/02/2004.

Station ID	Station Name	Region	Date	Time	Latitude (°N)	Longitude (°W)	Heading (°T)	SOG (kts)	Bottom Depth (m)	CK all	CM Juv	CM ad.	CO Juv	CO Ad.	PK Juv	PK Ad.	SE Juv	SE Ad.
HS200403IVI01	TREVOR CH	IVI	13-Feb-04	07:50	48.852	125.143	46	4.64	114	2	0	0	0	0	0	0	0	0
HS200403VI01	OFF BARKLEY SD, VI	VI	14-Feb-04	09:52	48.769	125.299	238	4.76	85	9	0	0	0	0	0	0	5	0
HS200403VI02	AMPHITRITE BK, VI	VI	14-Feb-04	12:42	48.906	125.631	318	4.87	84	2	0	0	0	0	0	0	0	0
HS200403VI03	LONG BEACH, VI	VI	14-Feb-04	14:30	48.976	125.823	275	5.38	44	2	0	0	0	0	0	0	0	0
HS200403VI04	LENNARD IS, VI	VI	14-Feb-04	16:12	49.055	126.026	312	5.79	54	3	0	0	0	0	0	0	0	0
HS200403VI05	OFF CLAYQUOT SD, VI	VI	14-Feb-04	18:00	49.163	126.261	310	6.35	58	22	1	0	1	0	0	0	1	0
HS200403EP01	ESTEVAN PT	VI	15-Feb-04	07:45	49.331	126.583	235	4.01	60	15	1	0	0	0	0	0	0	0
HS200403EP02	ESTEVAN PT	VI	15-Feb-04	09:11	49.312	126.630	231	5.04	96	3	0	0	0	0	0	0	0	0
HS200403EP03	ESTEVAN PT	VI	15-Feb-04	10:57	49.272	126.717	229	4.77	115	1	0	0	0	0	0	0	0	0
HS200403EP04	ESTEVAN PT	VI	15-Feb-04	12:41	49.240	126.768	241	4.74	121	7	0	0	0	0	0	0	0	0
HS200403EP05	ESTEVAN PT	VI	15-Feb-04	14:19	49.200	126.854	246	4.89	143	1	0	0	0	0	0	0	0	0
HS200403EP06	ESTEVAN PT	VI	15-Feb-04	15:42	49.165	126.929	243	5.09	206	0	0	0	0	0	0	0	0	0
HS200403IVI02	TAHSIS INLET, ESPERANZA	IVI	16-Feb-04	07:41	49.796	126.650	349	5.01	119	0	0	0	0	0	0	0	0	0
HS200403IVI03	TAHSIS INLET, ESPERANZA	IVI	16-Feb-04	09:23	49.887	126.660	182	5.05	190	0	0	0	0	0	0	0	0	0
HS200403IVI04	HECATE CH, ESPERANZA	IVI	16-Feb-04	11:22	49.878	126.764	333	5.47	256	3	0	0	0	0	0	0	0	0
HS200403IVI05	ZEBALLOS INLET, ESPERANZA	IVI	16-Feb-04	12:54	49.938	126.808	167	4.69	204	0	0	0	0	0	0	0	0	0
HS200403IVI06	ESPERANZA INLET	IVI	16-Feb-04	14:24	49.887	126.810	240	5.01	209	0	0	0	0	0	0	0	0	0
HS200403IVI07	ESPERANZA INLET	IVI	16-Feb-04	16:08	49.849	126.966	79	6.16	198	0	0	0	0	0	0	0	0	0
HS200403IVI08	ESPERANZA INLET	IVI	16-Feb-04	18:12	49.913	126.929	177	4.55	274	1	0	0	0	0	0	0	0	0
HS200403IVI09	ESPERANZA INLET	IVI	17-Feb-04	10:06	49.854	126.931	74	2.99	217	0	0	0	0	0	0	0	0	0
HS200403IVI10	ESPERANZA INLET	IVI	17-Feb-04	11:01	49.866	126.863	70	3.7	223	2	0	0	0	0	0	0	0	0
HS200403IVI11	QUATSINO SD	IVI	18-Feb-04	07:41	50.471	127.889	84	4.61	125	39	0	0	74	0	0	0	0	0
HS200403IVI12	QUATSINO SD	IVI	18-Feb-04	09:05	50.483	127.785	68	5.04	140	3	0	0	3	0	0	0	0	0
HS200403IVI13	QUATSINO SD	IVI	18-Feb-04	11:00	50.497	127.573	147	4.88	126	0	0	0	0	0	0	0	0	0
HS200403IVI14	QUATSINO SD	IVI	18-Feb-04	13:35	50.471	127.888	262	5.97	145	14	0	0	14	0	0	0	0	0
HS200403IVI15	QUATSINO SD	IVI	18-Feb-04	15:49	50.417	127.981	252	5.54	148	11	78	0	0	0	0	0	0	0
HS200403VI06	TOPKNOT PT, VI	VI	18-Feb-04	18:03	50.494	128.280	314	4.53	68	3	0	0	0	0	0	0	0	0
HS200403DE01	DIXON ENTRANCE - McINTRE B	DE	20-Feb-04	07:27	54.174	131.877	269	5.27	73	3	0	0	0	0	0	0	0	0
HS200403DE02	DIXON ENTRANCE - McINTRE B	DE	20-Feb-04	08:52	54.168	132.019	273	4.22	69	0	0	0	0	0	0	0	0	0
HS200403DE03	DIXON ENTRANCE - WIAH PT	DE	20-Feb-04	10:38	54.147	132.221	261	4.7	57	0	0	0	0	0	0	0	0	0

Table 2. Tow positions and catch summaries of Pacific salmon for the CCGS W.E. RICKER survey to the Gulf of Alaska, 13/02/2004 - 28/02/2004.

Station ID	Station Name	Region	Date	Time	Latitude (°N)	Longitude (°W)	Heading (°T)	SOG (kts)	Bottom Depth (m)	CK all	CM Juv	CM ad.	CO Juv	CO Ad.	PK Juv	PK Ad.	SE Juv	SE Ad.
HS200403DE04	DIXON ENTRANCE - KLASHWUN PT	DE	20-Feb-04	12:28	54.164	132.445	269	5.34	75	0	0	0	0	0	0	0	0	0
HS200403DE05	DIXON ENTRANCE - KLASHWUN PT	DE	20-Feb-04	14:07	54.182	132.669	289	6.75	65	0	0	0	0	0	0	0	0	0
HS200403DE06	DIXON ENTRANCE - LANGARA IS	DE	20-Feb-04	15:50	54.208	132.893	325	6.6	124	0	0	0	0	0	0	0	0	0
HS200403ISEA01	CLARENCE ST	ISEA	21-Feb-04	07:41	55.477	132.038	322	6.54	472	1	0	0	0	0	0	0	2	0
HS200403ISEA02	CLARENCE ST	ISEA	21-Feb-04	09:48	55.631	132.240	342	5.76	463	0	0	0	0	0	0	0	0	0
HS200403ISEA03	CLARENCE ST	ISEA	21-Feb-04	12:04	55.768	132.338	334	6.01	577	0	0	0	0	0	0	0	0	0
HS200403ISEA04	CLARENCE ST	ISEA	21-Feb-04	14:08	55.895	132.476	273	6.14	359	0	0	0	0	0	0	0	0	0
HS200403ISEA05	CLARENCE ST	ISEA	21-Feb-04	15:56	55.968	132.679	322	5.34	397	0	0	0	0	0	0	0	0	0
HS200403ISEA06	CLARENCE ST	ISEA	21-Feb-04	18:12	56.156	132.759	3	4.69	306	1	0	0	0	0	0	0	0	0
HS200403ISEA07	SUMNER ST	ISEA	22-Feb-04	07:48	56.379	133.385	262	6.04	324	29	0	0	0	0	0	0	0	0
HS200403ISEA08	STIKINE ST	ISEA	22-Feb-04	18:38	56.459	132.474	247	5.49	169	34	0	0	0	0	0	0	0	0
HS200403ISEA09	SUMNER ST	ISEA	23-Feb-04	07:59	56.390	133.555	283	6.48	358	26	0	0	0	0	0	0	0	0
HS200403ISEA10	SUMNER ST	ISEA	23-Feb-04	10:22	56.358	133.773	186	3.86	205	1	0	0	0	0	0	0	0	0
HS200403ISEA11	SUMNER ST	ISEA	23-Feb-04	12:14	56.279	133.787	173	4.48	290	1	0	0	0	0	0	0	0	0
HS200403ISEA12	SUMNER ST	ISEA	23-Feb-04	13:52	56.197	133.808	144	5.34	234	3	0	0	0	0	0	0	0	0
HS200403ISEA13	SUMNER ST	ISEA	23-Feb-04	15:34	56.100	133.788	204	5.67	278	0	0	0	0	0	0	0	0	0
HS200403ISEA14	SUMNER ST	ISEA	23-Feb-04	18:13	55.990	133.867	245	6.35	166	5	0	0	0	0	0	0	0	0
HS200403FI04	FORRESTER IS	SEA	24-Feb-04	17:48	54.753	133.428	83	4.82	139	0	0	0	0	0	0	0	0	0
HS200403FI03	FORRESTER IS	SEA	24-Feb-04	18:42	54.763	133.332	79	4.58	129	0	0	0	0	0	0	0	0	0
HS200403SEA01	DALL IS	SEA	25-Feb-04	07:32	54.935	133.216	148	4.4	101	1	0	0	0	0	0	0	0	0
HS200403SEA02	DALL IS	SEA	25-Feb-04	09:02	54.860	133.143	161	5.47	106	0	0	0	0	0	0	0	0	0
HS200403FI02	FORRESTER IS	SEA	25-Feb-04	10:43	54.780	133.169	78	4.6	186	0	0	0	0	0	0	0	0	0
HS200403FI01	FORRESTER IS	SEA	25-Feb-04	12:31	54.777	133.028	122	5.64	191	0	0	0	0	0	0	0	0	0
HS200403SEA03	DALL IS	SEA	25-Feb-04	14:38	54.698	132.930	139	4.77	152	1	0	0	0	0	0	0	0	0
HS200403SEA04	DALL IS	SEA	25-Feb-04	16:21	54.617	132.769	136	5.37	250	0	0	0	0	0	0	0	0	0
HS200403ISEA15	C MUZON	ISEA	25-Feb-04	18:08	54.623	132.588	93	4.59	134	0	0	0	0	0	0	0	0	0
HS200403T07	TRIANGLE IS	VI	27-Feb-04	15:31	50.826	129.238	293	5.13	71	0	0	0	0	0	0	0	0	0
HS200403T06	TRIANGLE IS	QCSD	27-Feb-04	17:59	50.942	128.978	54	5.07	59	0	0	0	0	0	0	0	0	0
HS200403T05	TRIANGLE IS	QCSD	28-Feb-04	07:25	51.011	128.851	50	4.81	58	0	0	0	0	0	0	0	0	0
HS200403T04	TRIANGLE IS	QCSD	28-Feb-04	08:52	51.083	128.726	55	4.8	60	0	0	0	0	0	0	0	0	0

Table 2. Tow positions and catch summaries of Pacific salmon for the CCGS W.E. RICKER survey to the Gulf of Alaska, 13/02/2004 - 28/02/2004.

Station ID	Station Name	Region	Date	Time	Latitude (°N)	Longitude (°W)	Heading (°T)	SOG (kts)	Bottom Depth (m)	CK all	CM Juv	CM ad.	CO Juv	CO Ad.	PK Juv	PK Ad.	SE Juv	SE Ad.
HS200403T03	TRIANGLE IS	QCSD	28-Feb-04	10:52	51.151	128.588	54	4.67	146	0	0	0	0	0	0	0	0	0
HS200403T02	TRIANGLE IS	QCSD	28-Feb-04	12:32	51.217	128.452	63	5.24	181	0	0	0	0	0	0	0	0	0
HS200403T01	TRIANGLE IS	QCSD	28-Feb-04	14:07	51.272	128.318	146	4.76	69	0	0	0	0	0	0	0	0	0
									Totals	249	80	0	92	0	0	0	8	0
															Overall total			429

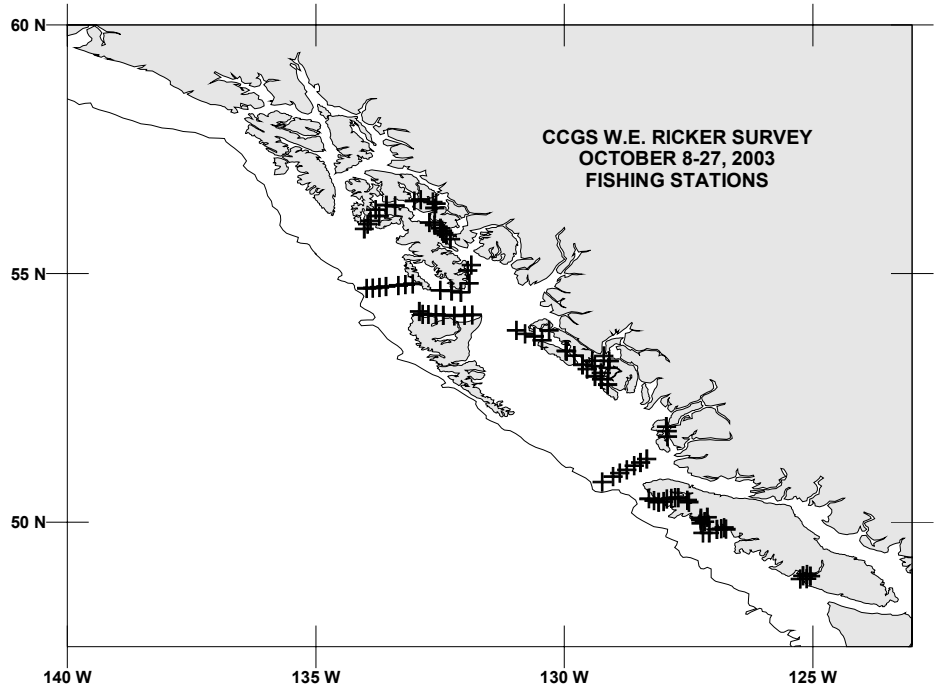

Figure 1. Fishing stations on the fall, 2003 survey.

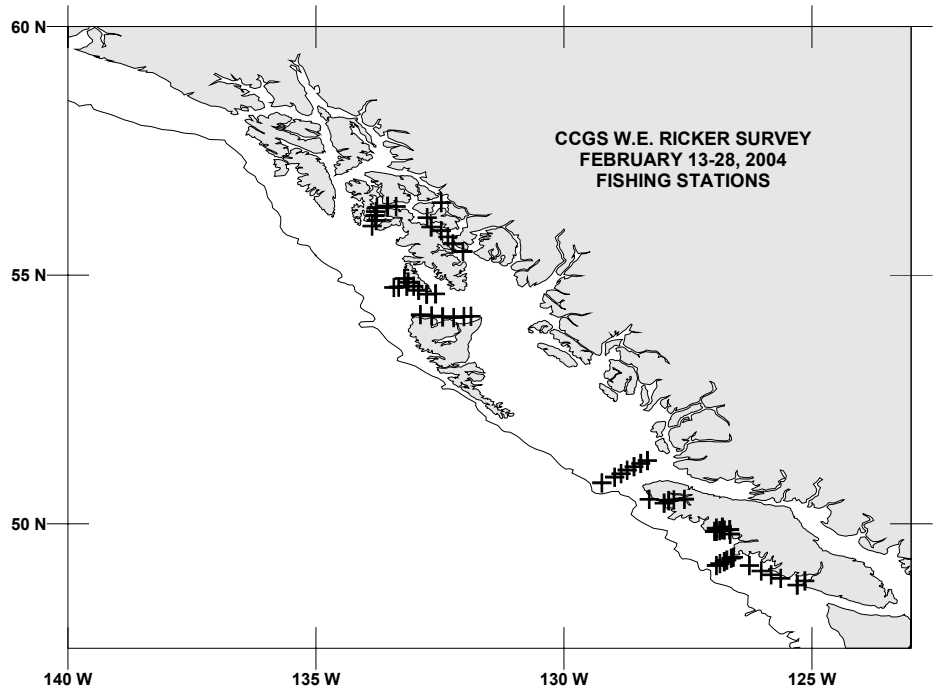

Figure 2. Fishing stations on the winter, 2004 survey.

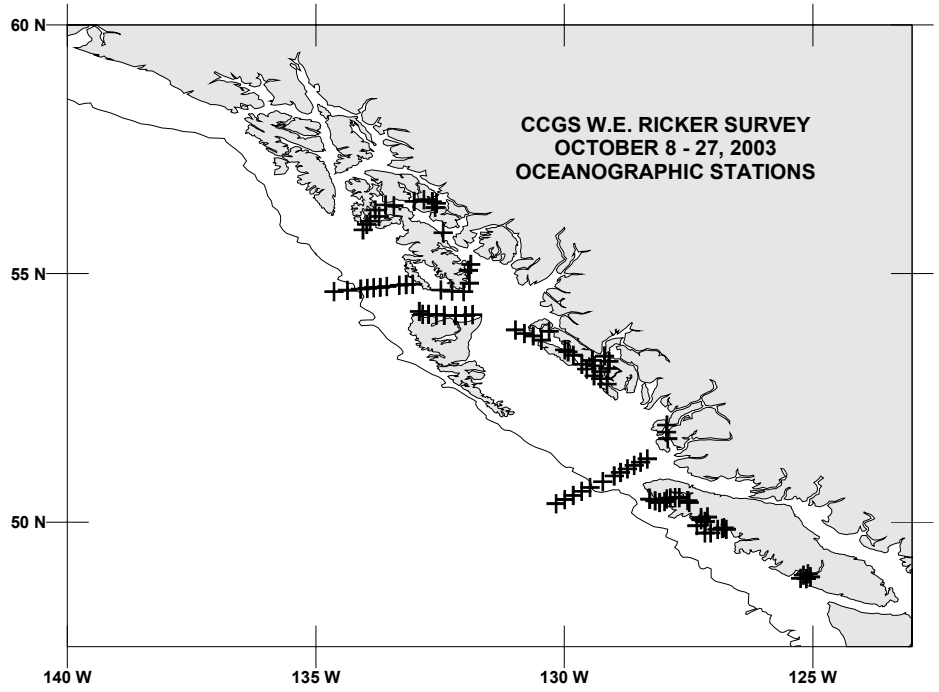

Figure 3. Oceanographic stations on the fall, 2003 survey.

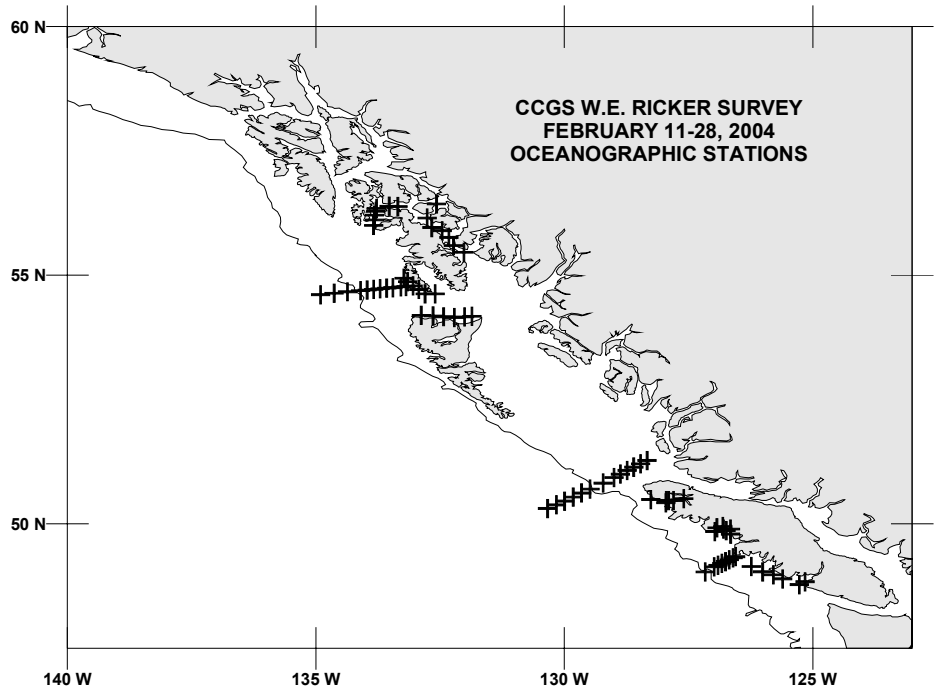

Figure 4. Oceanographic stations on the winter, 2004 survey.

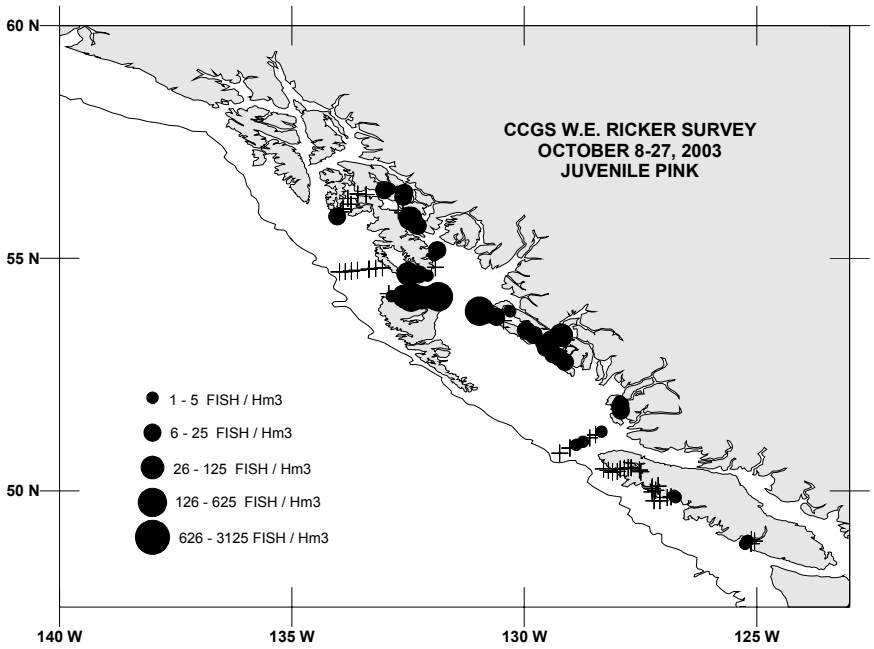

Figure 5. Fall distribution of juvenile pink salmon (age 0.0).

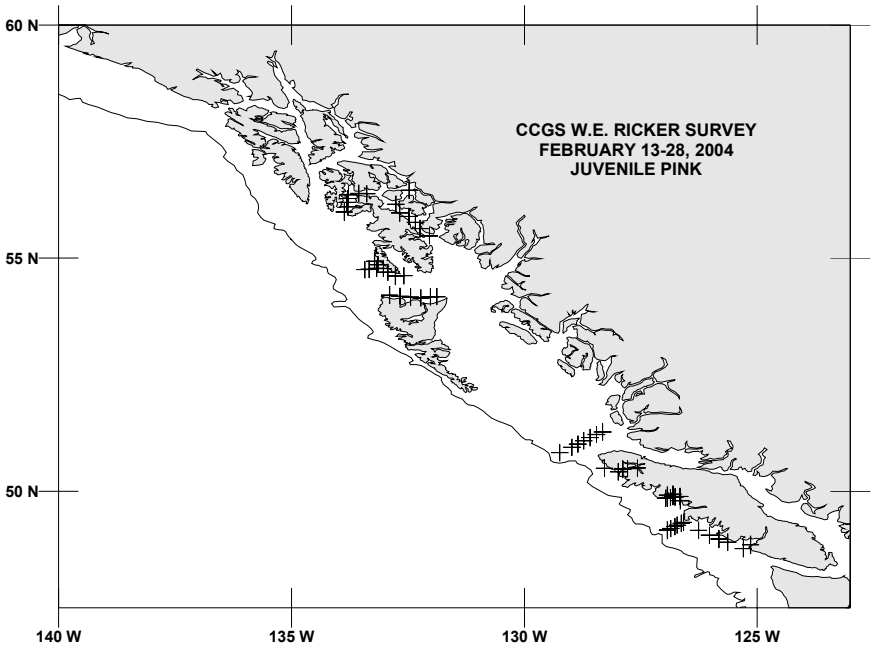

Figure 6. Winter distribution of juvenile pink salmon (age 0.1).

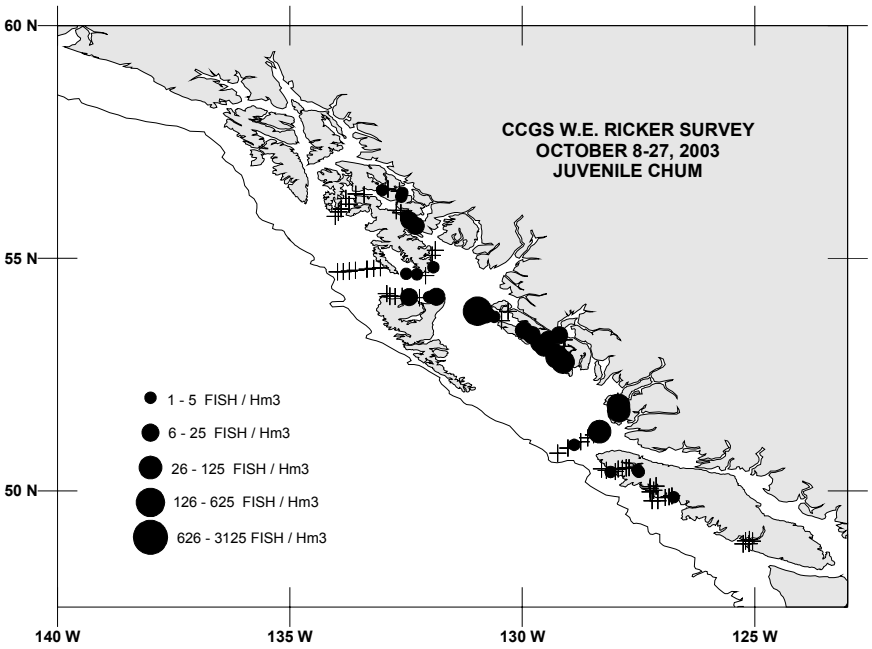

Figure 7. Fall distribution of juvenile chum salmon (age 0.0).

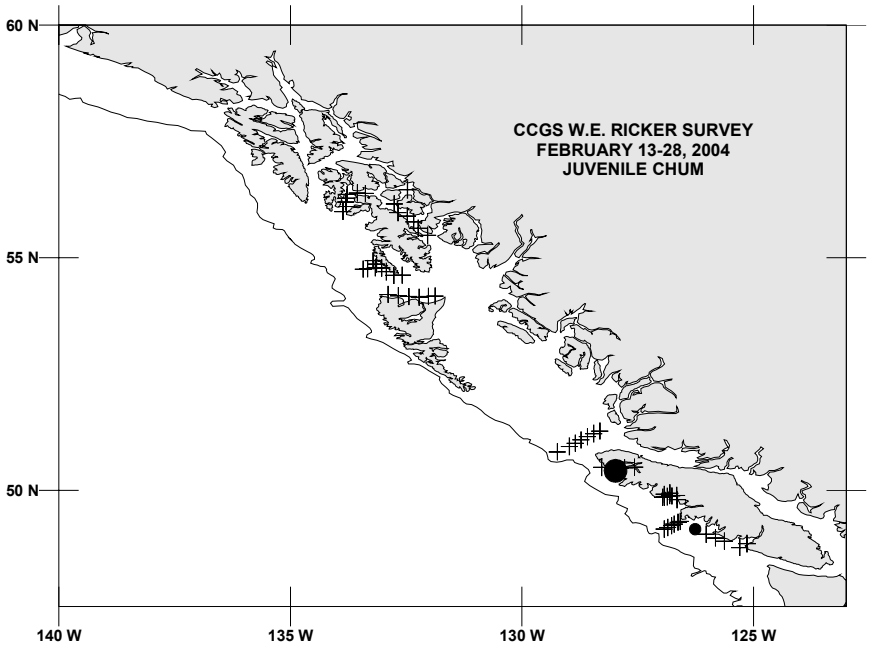

Figure 8. Winter distribution of juvenile chum salmon (age 0.1).

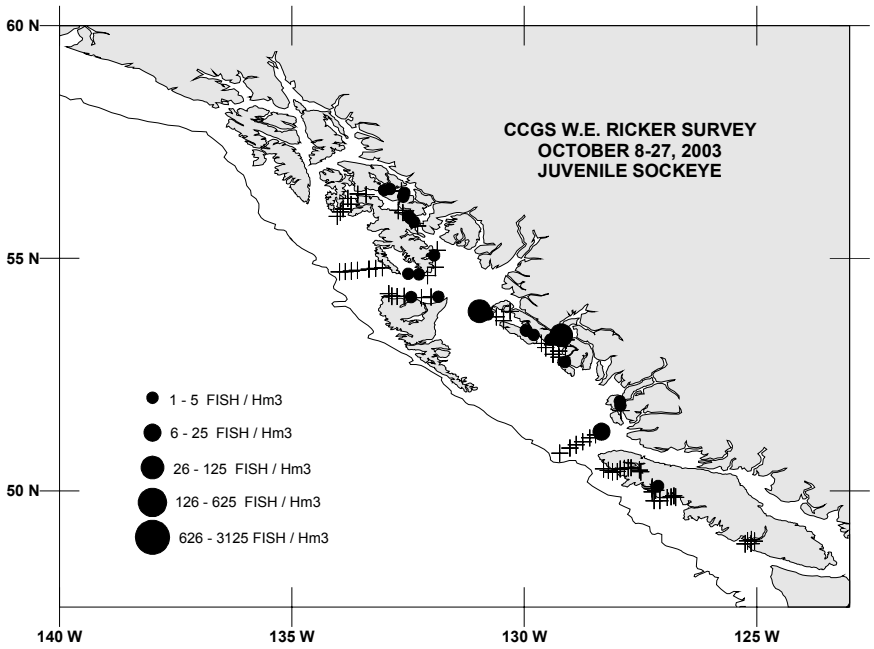

Figure 9. Fall distribution of juvenile sockeye salmon (age X.0).

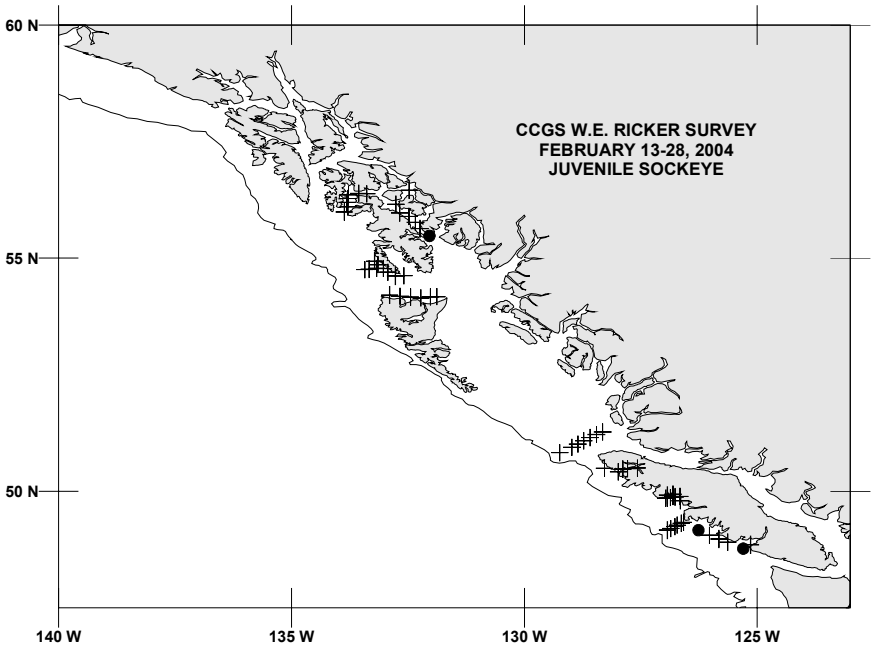

Figure 10. Winter distribution of juvenile sockeye salmon (age X.1).

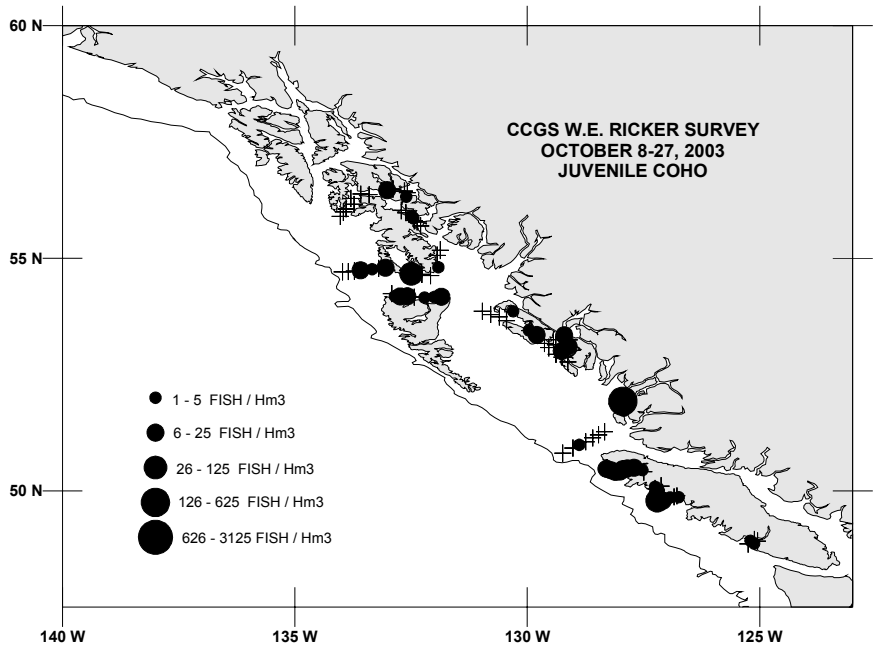

Figure 11. Fall distribution of juvenile coho salmon (age X.0).

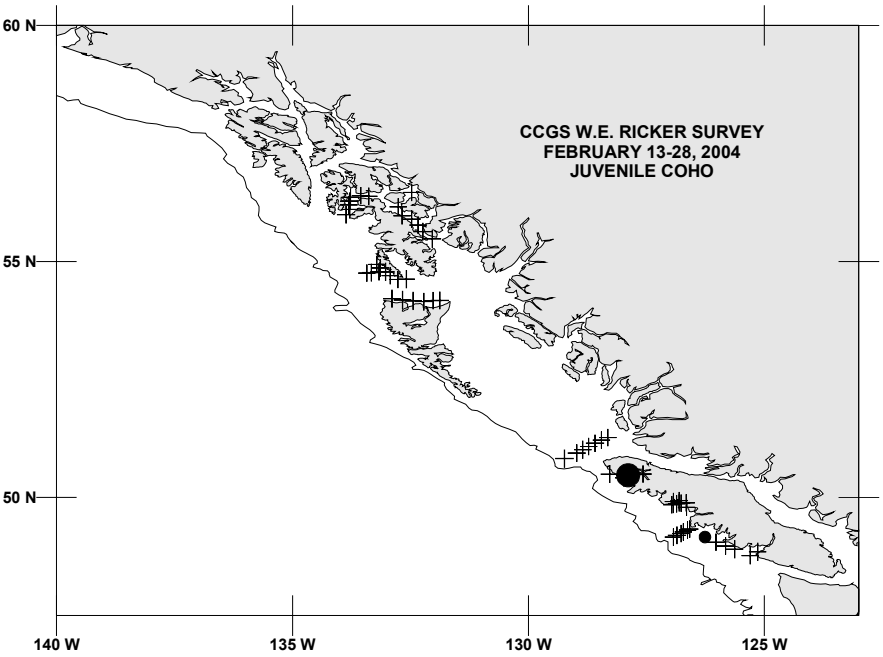

Figure 12. Winter distribution of juvenile coho salmon (age X.1).

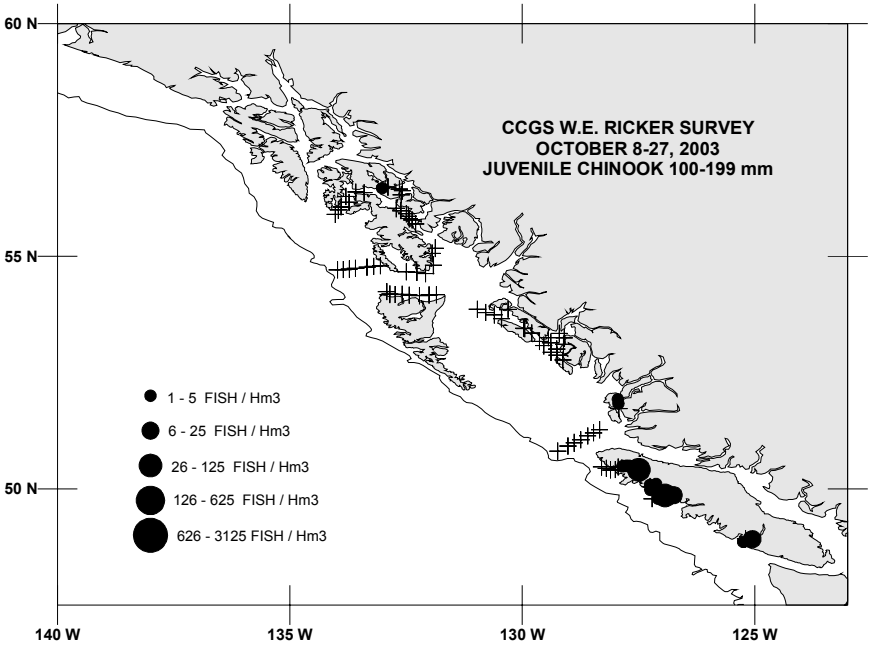

Figure 13. Fall distribution of juvenile chinook from 100 to 199 mm in fork length.

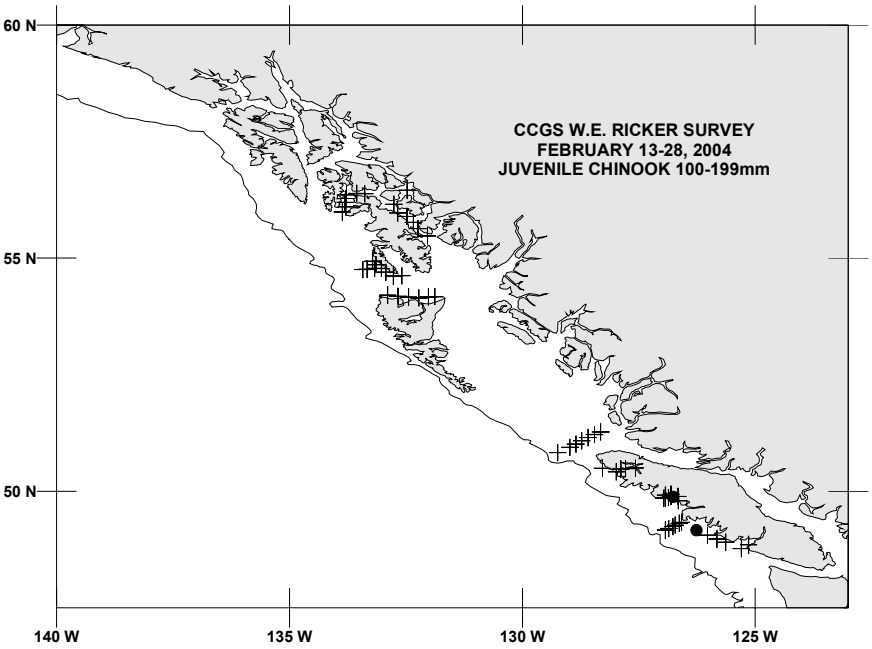

Figure 14. Winter distribution of juvenile chinook from 100 to 199 mm in fork length.

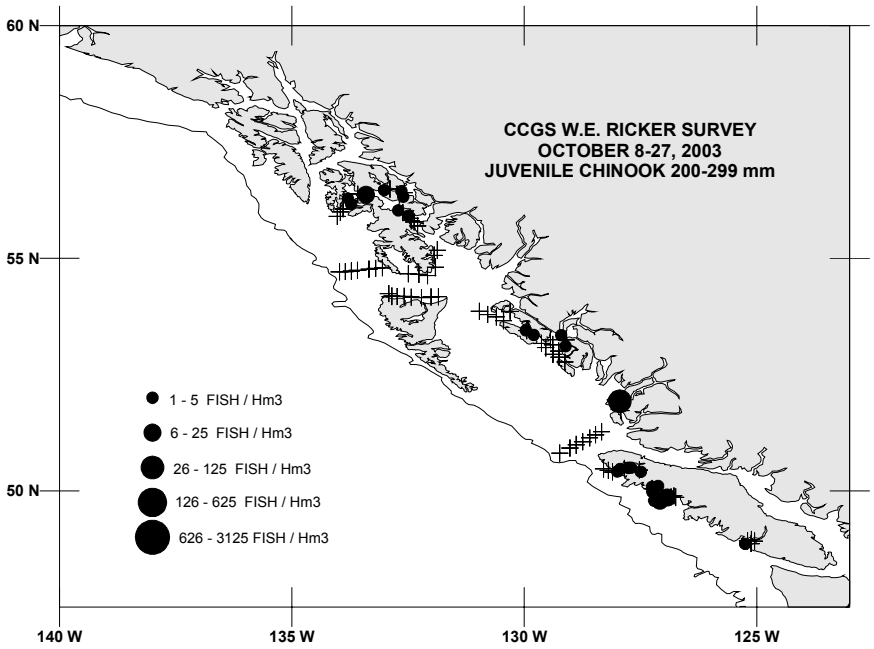

Figure 15. Fall distribution of juvenile chinook from 200 to 299 mm in fork length.

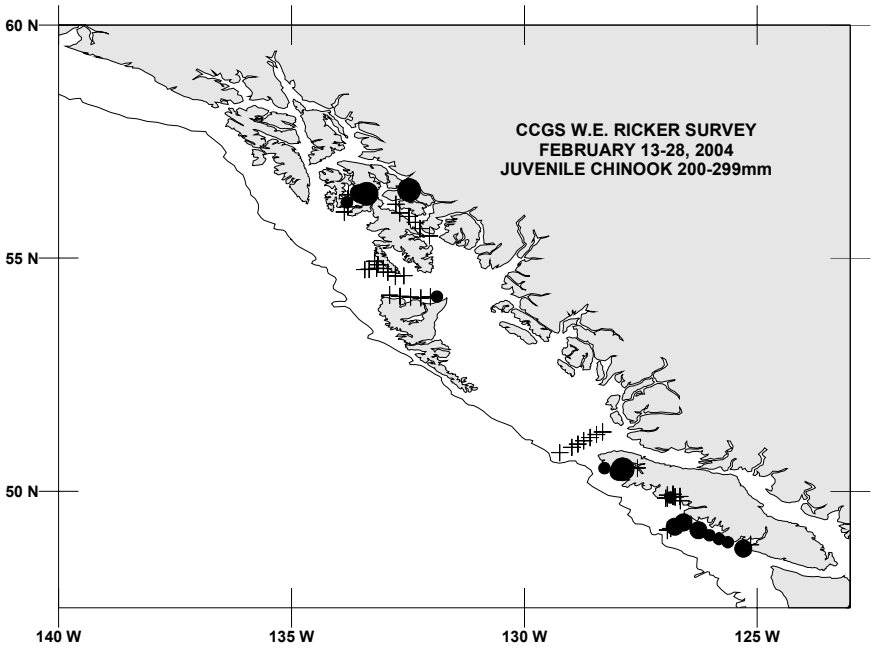

Figure 16. Winter distribution of juvenile chinook from 200 to 299 mm in fork length.

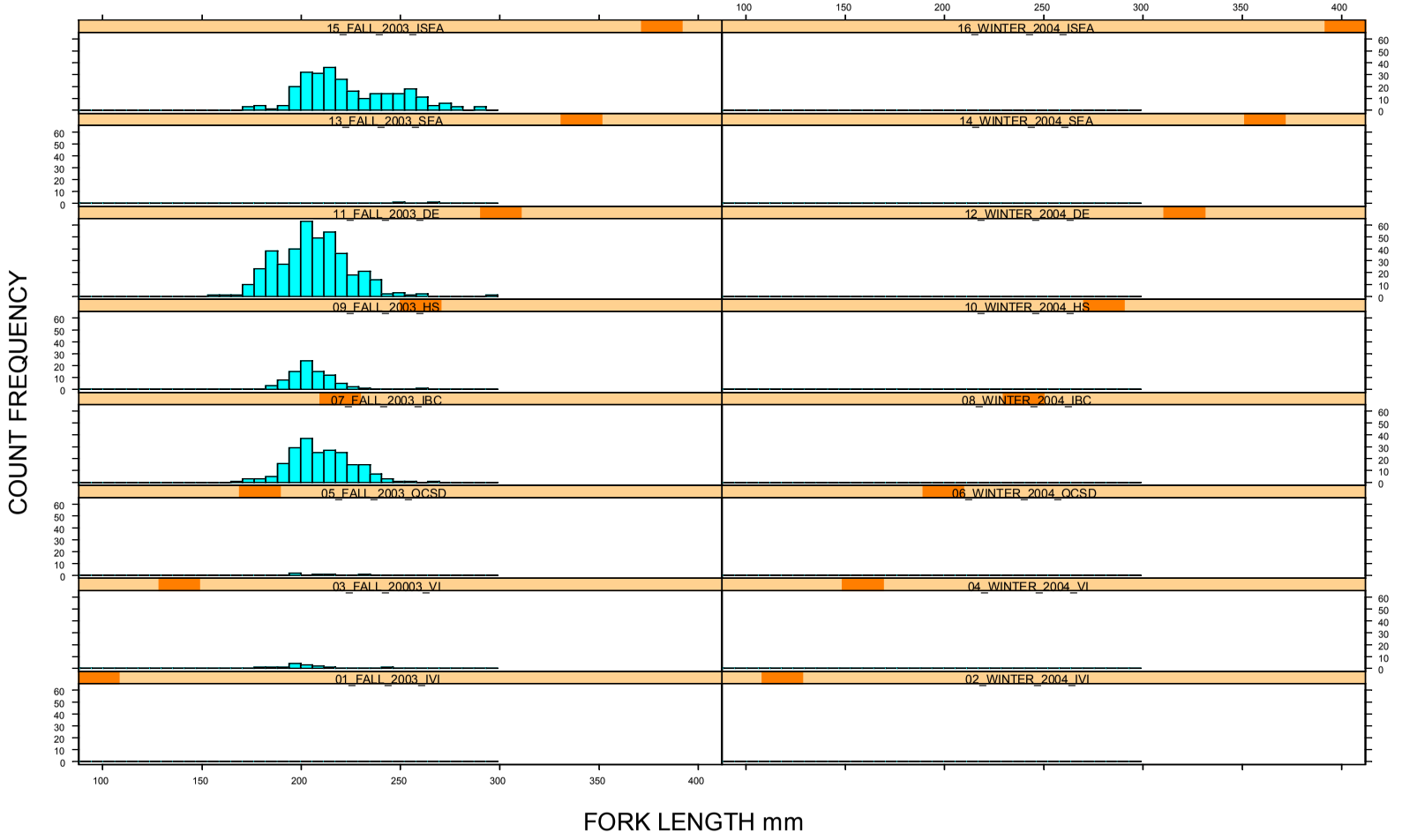

Figure 17. Size frequencies by geographic regions(north-top; south-bottom) and by seasons (fall 2003-left; winter 2004-right) for juvenile pink salmon.

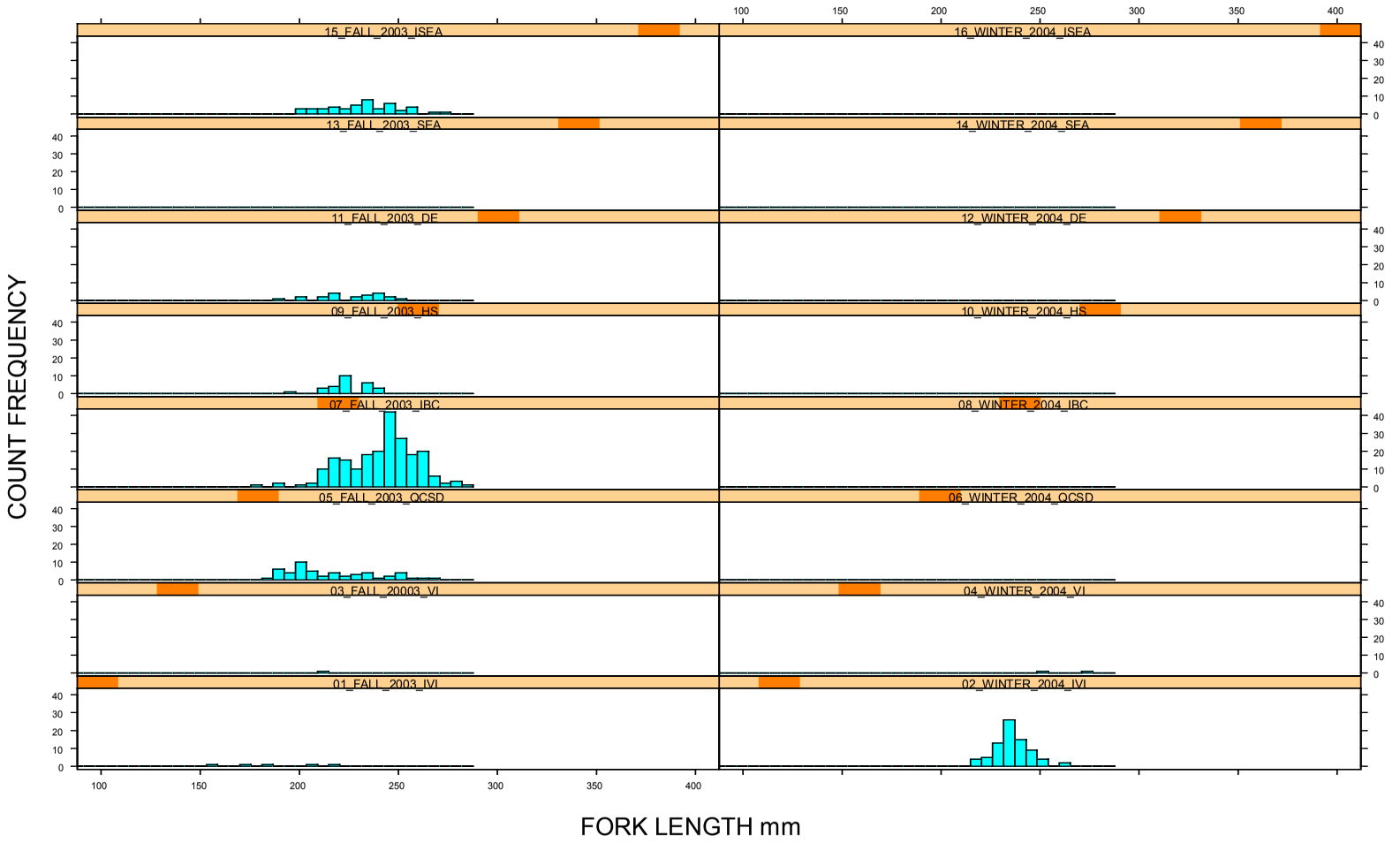

Figure 18. Size frequencies by geographic regions(north-top; south-bottom) and by seasons (fall 2003-left; winter 2004-right) for juvenile chum salmon.

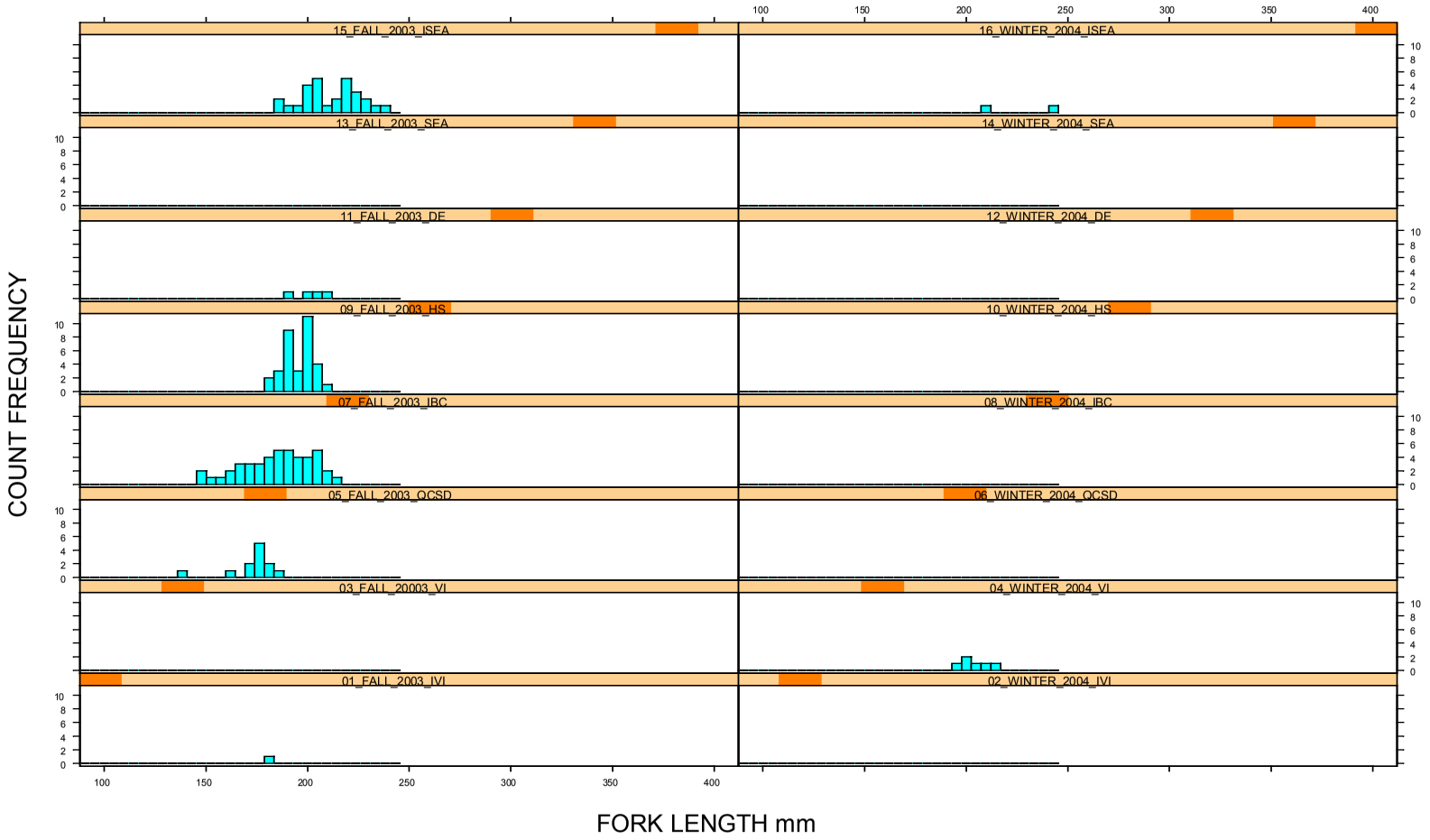

Figure 19. Size frequencies by geographic regions(north-top; south-bottom) and by seasons (fall 2003-left; winter 2004-right) for juvenile sockeye salmon.

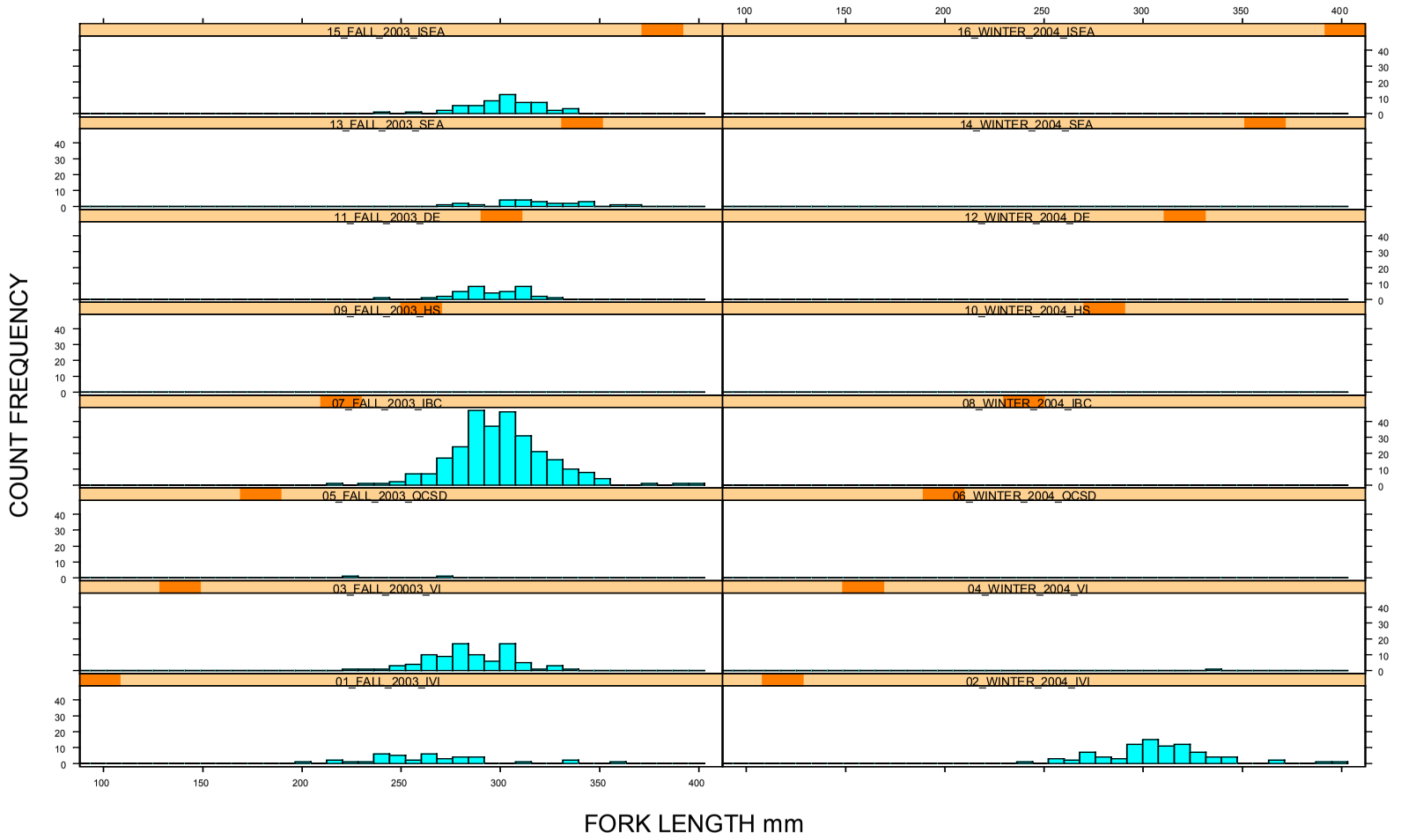

Figure 20. Size frequencies by geographic regions(north-top; south-bottom) and by seasons (fall 2003-left; winter 2004-right) for juvenile coho salmon.

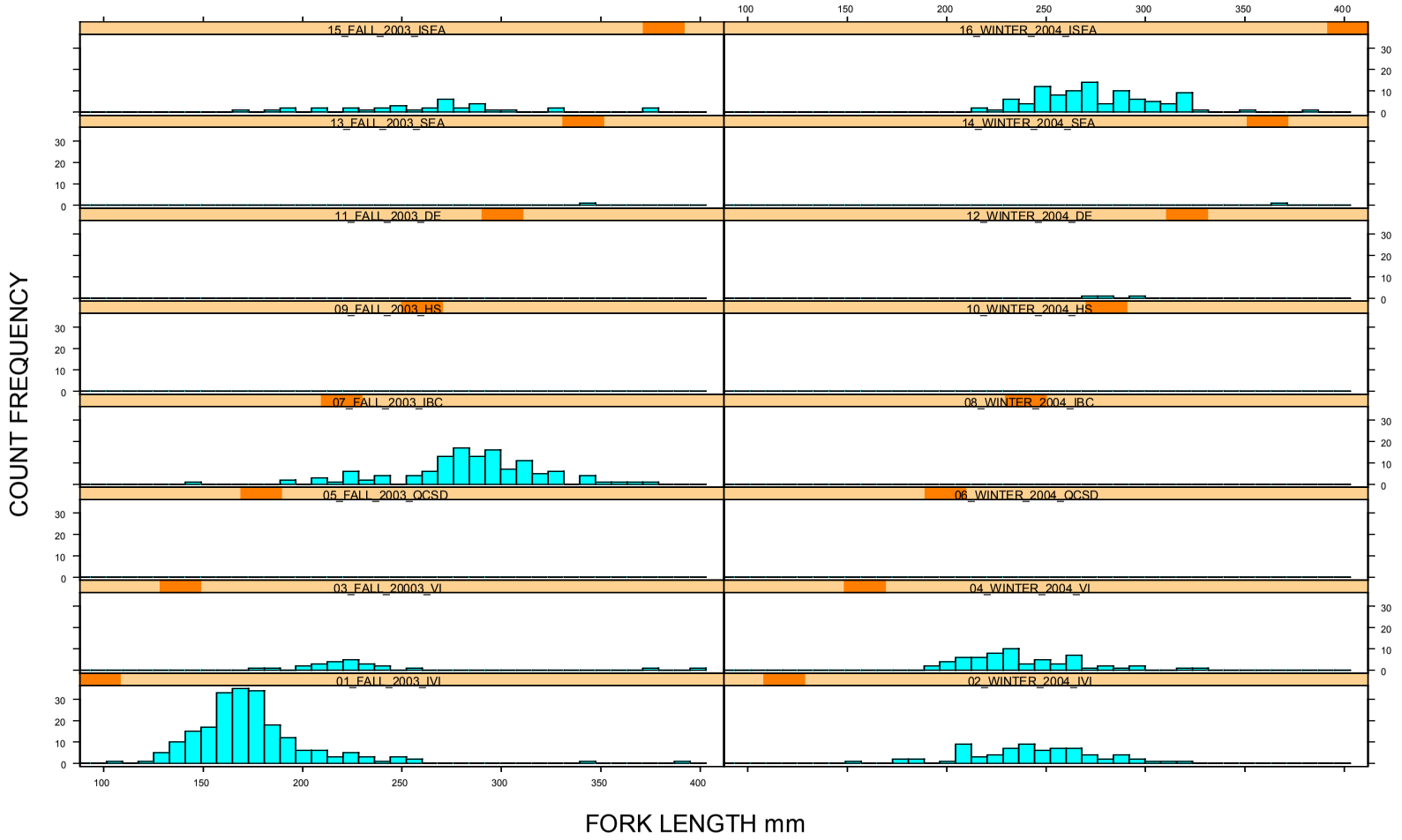

Figure 21. Size frequencies by geographic regions(north-top; south-bottom) and by seasons (fall 2003-left; winter 2004-right) for chinook salmon.