Inner South Coast Pink Stock Reconstructions (1953-2016)*

Escapement and Total Stock Reconstructions by Conservation Units

This document outlines the methods used to reconstruct the pink salmon escapement time series for the ISC Pink CUs and details the updated time series of escapement data. From the escapement reconstructions assignment of catch by CU is determined and total stock (Catch + Escapement) is estimated. A preliminary assessment of benchmarks is provided from which status of each ISC Pink CU was derived

.*Catch data from 2015 is incomplete and will be updated at a later date. Catch numbers in 2015 were low for most gear groups

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Background

Inner South Coast (ISC) Pinks are grouped into 8 conservation units (CUs) that extend over the entire East Coast of Vancouver Island as well from Seymour Inlet down to Burrard inlet on the Mainland of British Columbia (Holtby and Ciruna, 2007) (Table 1, Figure 1 and Figure 2). All pink salmon mature at 2 years of age which results in the reproductive isolation of even and odd year brood lines (Beacham et al. 1985). Within the ISC region there are many systems (Table 2) that support both even and odd year brood lines and the methods for identifying CUs take that into account (Holtby and Ciruna, 2007).

Table 1. Identified Conservation Units and numbers of streams for ISC Pink Salmon

Brood Line	Conservation Units	Number of streams
Even Year	Southern Fjords	102
	Georgia Strait	66
	Total	**168**
Odd Year	Nahwitti	9
	Southern Fjords	48
	East Vancouver Island-Johnstone Strait	12
	Georgia Strait	72
	East Howe Sound-Burrard Inlet	13
	Homathko-Klinaklini	20
	Total	**174**

Table 2. Population Structure of Inner South Coast pink salmon

Bold font indicates systems which are currently surveyed for escapement estimates. A complete list of sites for each Conservation Unit (CU) is available at http://www-comm.pac.dfo-mpo.gc.ca/pages/consultations/wsp/CUs_e.htm. *Underlined italic font with an asterisk** marks systems with active hatchery enhancement. Methods for identifying CUs are documented in Holtby and Ciruna (2007). Note that pink salmon CUs distinguish between even-year returns and odd-year returns.

Conservation Units		Stat Area	Assessment Area	Spawning Sites (Note: some sites only have even or odd-year runs)
Even	Odd			
Southern Fjords	Southern Fjords[2]	11	Seymour Inlet	Eva Creek, Driftwood Creek, Pack Lake Creek, Rainbow Creek, Seymour River, Waump Creek
		12	Loughborough to Bute	Blind Creek, Boughey Creek, Fulmore River, Robbers Knob Creek
			Bond to Knight	**Ahnuhati River**, **Ahta River**, Ahta Valley Creek, Call Creek, **Gilford Creek**, **Glendale Creek**, Hoeya Sound Creek, **Kakweiken River**, Kamano Bay Creek, Klinaklini River[2], **Kwalate Creek**, **Lull Creek**, Maple Creek, Matsui Creek, McAlister Creek, Port Harvey Lagoon Creeks, Potts Lagoon Creek, Protection Point Creek, Sallie Creek, Shoal Harbour Creek, Sim River, **Viner Sound Creek**
	East VI - JS		Johnstone Strait	**Adam River**, Charles Creek, Eve River, Hyde Creek, *Kokish River**, Mills Creek, Naka Creek, **Nimpkish River**, Stranby River, Thiemer Creek, **Tsitika River,** Tuna River
	HKRSBCD[1]		Kingcome Inlet	Bughouse Creek, Carriden Creek, Charles Creek, Cohoe Creek, **Embley Creek**, Hauskin Creek, Health Lagoon Creek, Jennis Bay Creek, **Kingcome River**, Mackenzie River, Nimmo Creek, Scott Cove Creek, Simoom Sound Creek, **Wakeman River,** Waldon Creek
	Nahwitti		Upper Vancouver Island	***Cluxewe River***, **Keogh River**, Nahwitti River, ***Quatse River***, Shushartie River, Songhees Creek, Stranby River, Tsulquate River
S. Fjords & Georgia Strait	Southern Fjords[2]	13	Loughborough to Bute	**Apple River**, Cameleon Harbour Creek, Clear Creek, Cumsack Creek[2], Drew Creek, Fanny Bay Creek, Frazer Creek, Frederick Arm Creek, George Creek, Granite Bay Creek, **Grassy Creek**, **Gray Creek**, Hemming Bay Creek, Heydon Creek, Homathko River[2], Hyacinthe Creek, Kanish Creek, Knox Bay Creek, Open Bay Creek, **Orford River**, **Phillips River**, Quatam River, **Read Creek**, Southgate River, St. Aubyn Creek, Stafford River, Teaquahan River, Thurston Bay Creek, **Wortley Creek**

Conservation Units		Stat Area	Assessment Area	Spawning Sites (Note: some sites only have even or odd-year runs)
Even	Odd			
	East VI–JS & GS		Johnstone Strait	**Amor de Cosmos Creek**, **Menzies Creek**, **Mohun Creek**, Quatam River, **Salmon River**, White River
Georgia Strait	Georgia Strait	13	Mid-Vancouver Island	***Campbell River****, ***Quinsam River****, Simms Creek, Pye Creek
		14	Mid-Vancouver Island	Brooklyn Creek, ***Englishman River****, French Creek, Headquarters Creek, Little Qualicum River, Millard Creek, Morrison Creek, *Nile Creek**, ***Oyster River****, ***Puntledge River****, **Qualicum River**, Trent River, Tsable River, ***Tsolum River****, Wilfred Creek
		15	Toba Inlet Jervis Inlet	Brem River, Brem River Tributary, Forbes Bay Creek, Klite River, Okeover Creek, Theodosia River, Toba River **Lang Creek**, **Sliammon Creek, Whittall Creek**
		16	Jervis Inlet	Angus Creek, Brittain River, Carlson Creek, *Chapman Creek**, Deserted River, Gray Creek, Sechelt Creek, Shannon Creek, Skwawka River, Tzoonie River, Vancouver River
		17		Holland Creek, *Nanaimo River**
		29	Boundary Bay	*Nicomekl River**
	East Howe Sound / Burrard Inlet	28	Squamish – Howe Sound	Cheakamus River, Elaho River, Mamquam River, Stawamus River, Squamish River
			Burrard Inlet – Indian Arm	Lynn Creek, MacKay Creek, *Seymour River**, Capilano River (Brothers Creek), and Indian River

[1] Homathko-Klinaklini-Rivers-Smith-Bella Coola Dean

[2] These populations fall mostly into the *Southern Fjords* CU, except for Cumsack Creek, Klinaklini River, and Homathko River, which were grouped with the *Homathko-Klinaklini-Rivers-Smith-Bella Coola Dean* CU based on "predominant genetic clusters in closely related Freshwater Adaptive Zones" (Holtby and Ciruna 2007).

Data Sources

Data for the reconstructions was compiled from a variety of sources. All escapement data by year was exported from the NUSEDS database from 1953 to 2011. NUSED also houses the CU groupings along with the stream names and final estimates of escapement for each monitored stream in a given year. The catch data associated with Southern BC commercial fisheries was compiled from a variety of sources. Catch data for odd year came from 2 main sources DFO yearly reports (1953-1987) and then

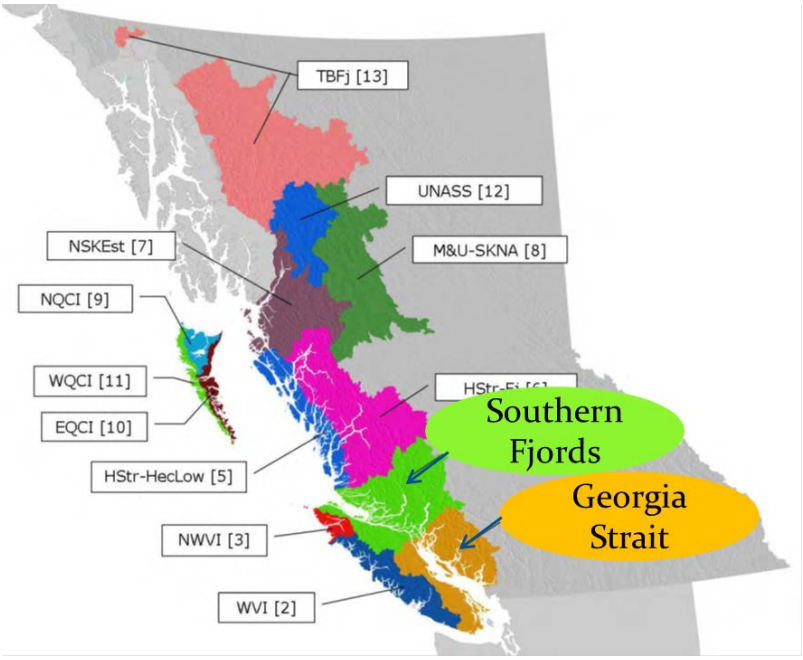

Figure 1. Even year Pink CUs identified in Holtby and Ciruna, 2007. The two even Year CU for ISC Pinks have been highlighted

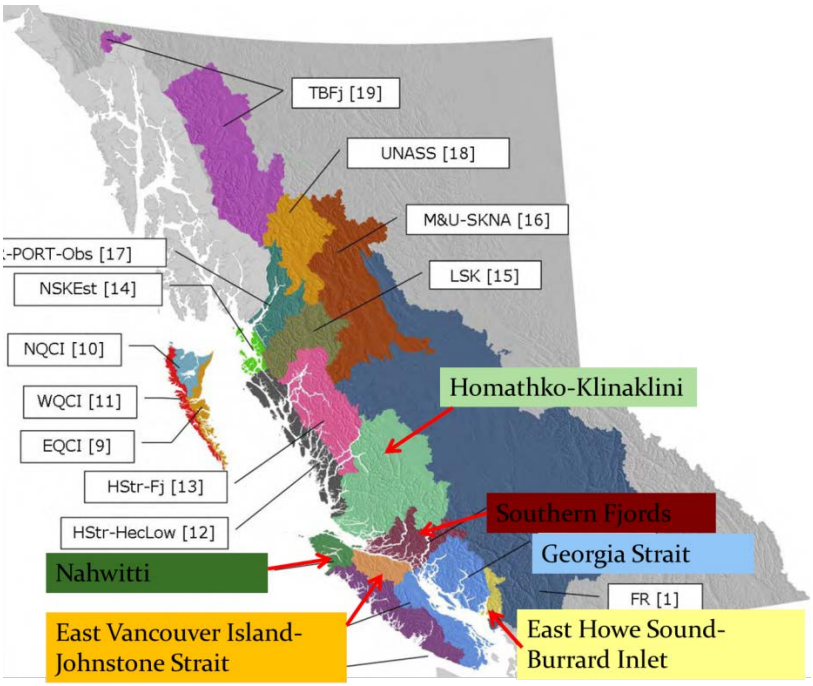

Figure 2. Odd year Pink CUs identified in Holtby and Ciruna, 2007. The five odd year CUs for ISC pink have been highlighted

The Pacific Salmon Commission (1989-2011). The catch data prior to 1989 was derived through older stock reconstructions used to separate out Fraser and Non Fraser Stocks (Zyblut and Anderson, 1973, more reports through 1988). Catch from 1989 on have been derived using GSI techniques but PSC staff and catch data is provided separated out as Canadian Non Fraser Catch. Catch for even year pinks is all assumed to be associated with Inner South Coast pinks due to the lack of even year returns to the Fraser and other locations to the South. Catch has been tabulated from past reports and from the DFO Commercial catch databases (i.e. Fisheries Operating System or FOS).Table 3

Escapement Time Series Reconstruction

Pink salmon in the ISC region are typically assessed through visual surveys. Peak counts or AUC derived estimates from multiple visits tend to be the main estimate methodology. Even though there are issues with the quality of the escapement data (variation in observers and variability in the levels of coverage) it is sufficient to understand overall trends in the abundance over time. The periodicity of escapement monitoring in the ISC region has resulted in significant gaps in the dataset. In order to reconstruct the escapement for all pink producing streams in a given CU, the gaps in the escapement

time series need to be in-filled. Data compiled from NUSEDS was grouped by CU prior to applying the in-fill technique. The geometric mean of each stream's escapement across years was calculated and assigned as the stream's average escapement. The total average escapement for the CU in a given year was simply the sum of all stream average escapements within that CU and year. The proportion of monitored escapement covered in a given year was determined by summing up the average escapements of all streams monitored in a given year divided by the total average escapement for all streams in that area. The reconstructed escapement of a given CU and year was then simply the summation of observed escapements for that year and CU divided by the proportion of monitored escapement for that year and CU. This method of reconstructing the escapement was applied to the two even years and the six odd year ISC Pink Salmon CUs (Figure 3, Figure 4, Figure 5, Figure 6, Figure 7, Figure 8, Figure 9, and Figure 10).

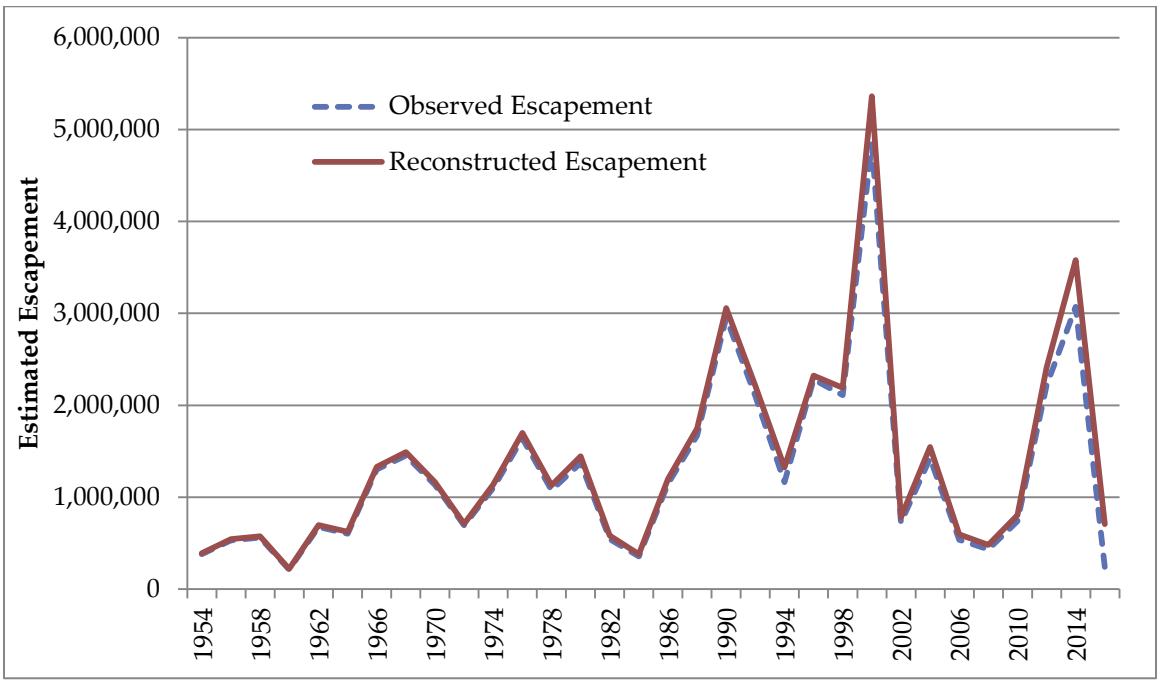

Figure 3. Observed and Reconstructed Escapement Time Series for the Southern Fjords Even Year Pink Salmon CU

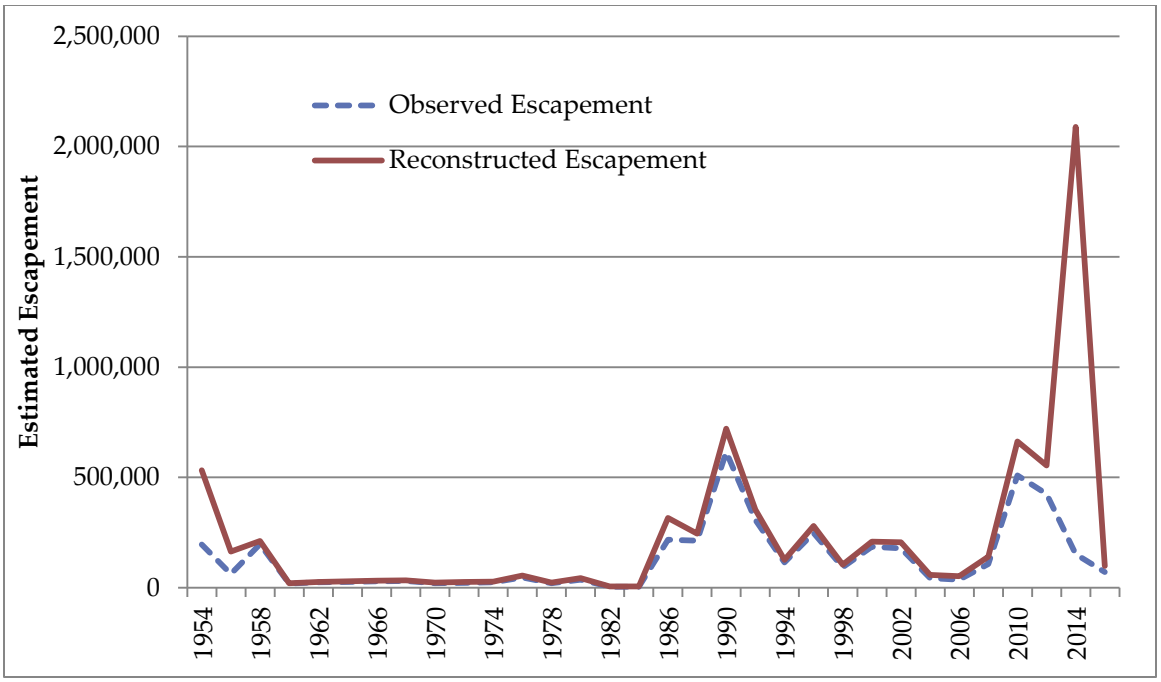

Figure 4. Observed and Reconstructed Escapement Time Series for the Georgia Strait Even Year Pink Salmon CU

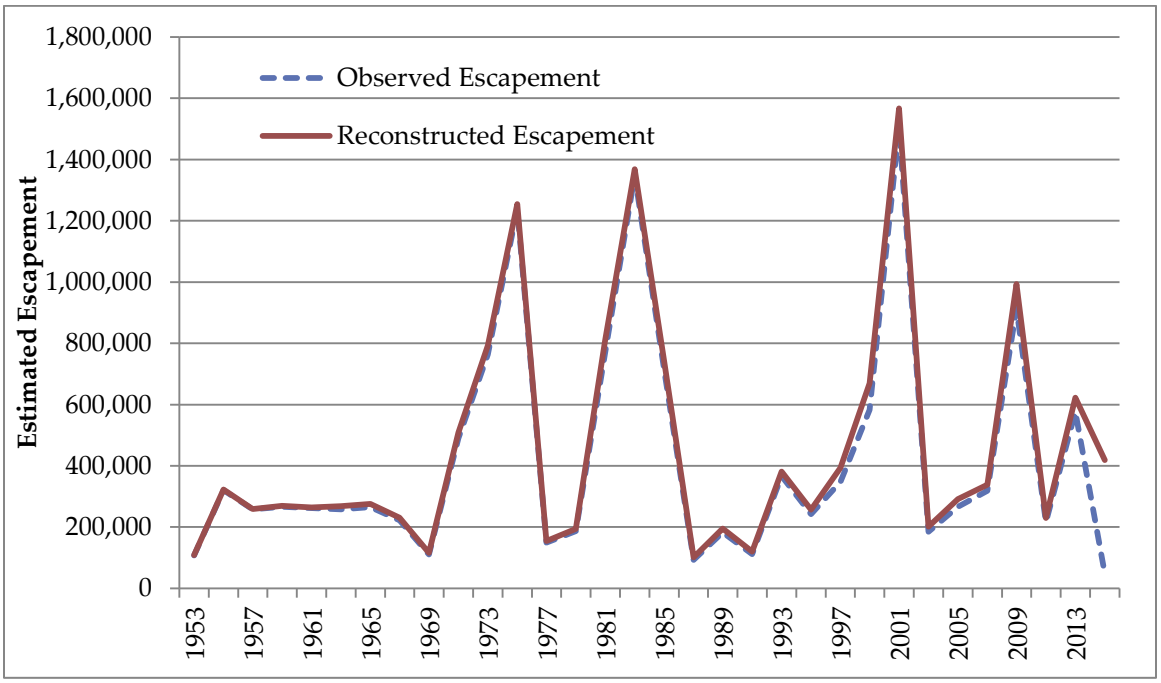

Figure 5. Observed and Reconstructed Escapement Time Series for the Southern Fjords Odd Year Pink Salmon CU

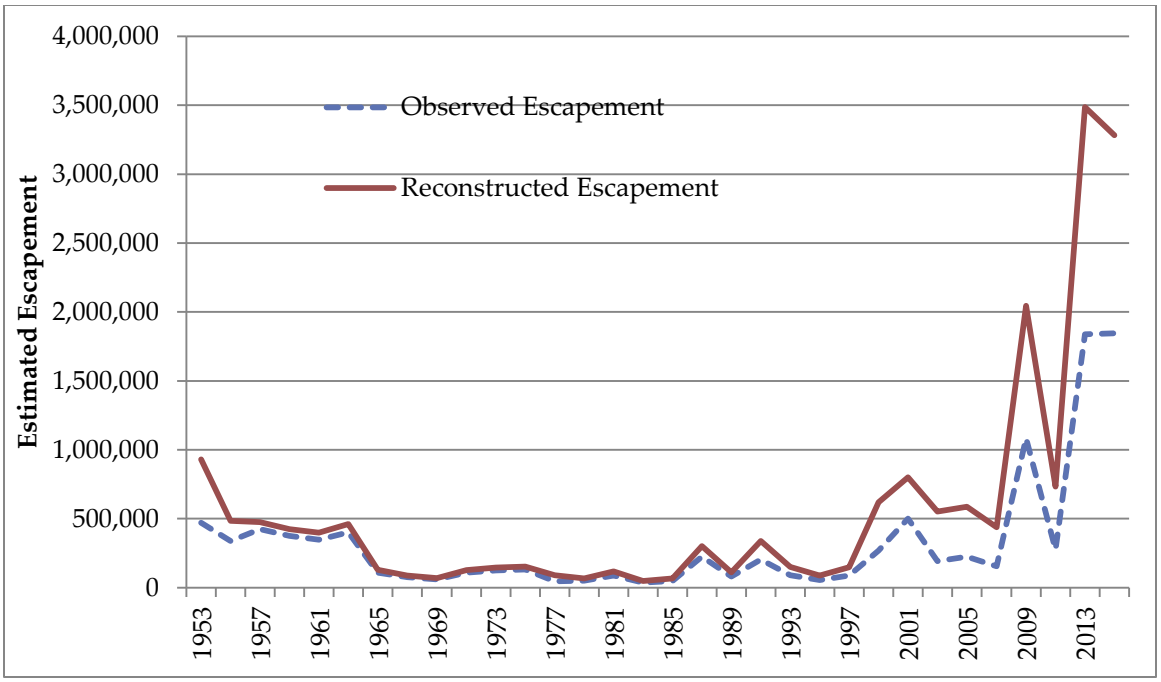

Figure 6. Observed and Reconstructed Escapement Time Series for the Georgia Strait Odd Year Pink Salmon CU

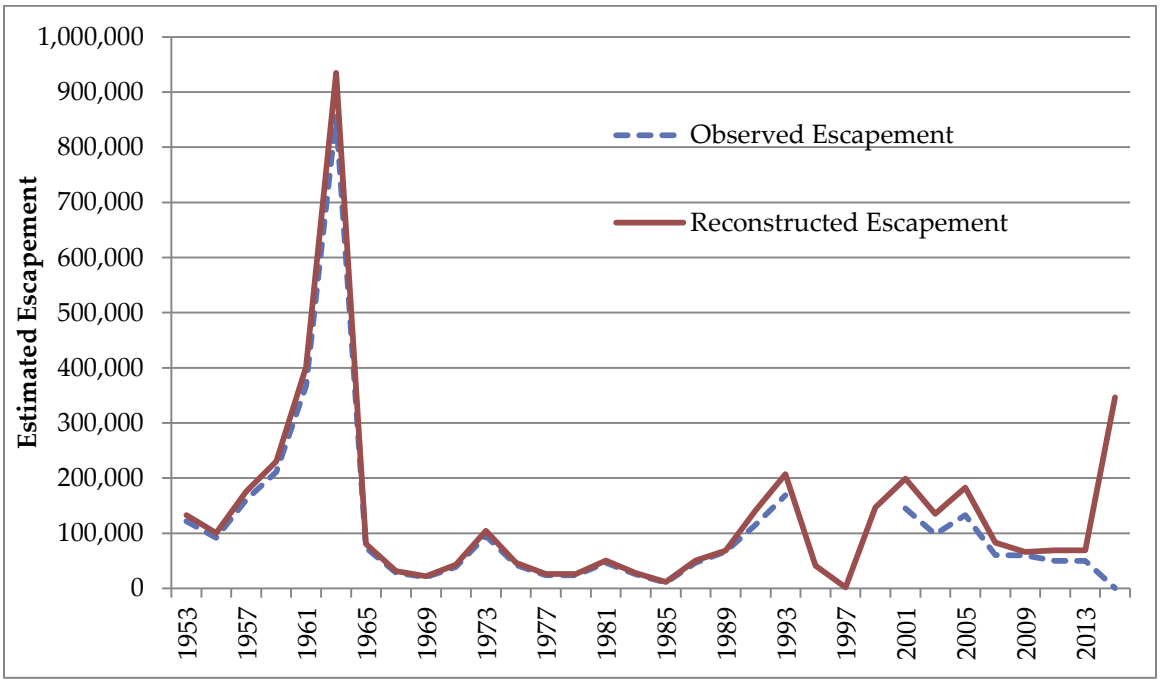

Figure 7. Observed and Reconstructed Escapement Time Series for the East Howe Sound-Burrard Inlet Odd Year Pink Salmon CU

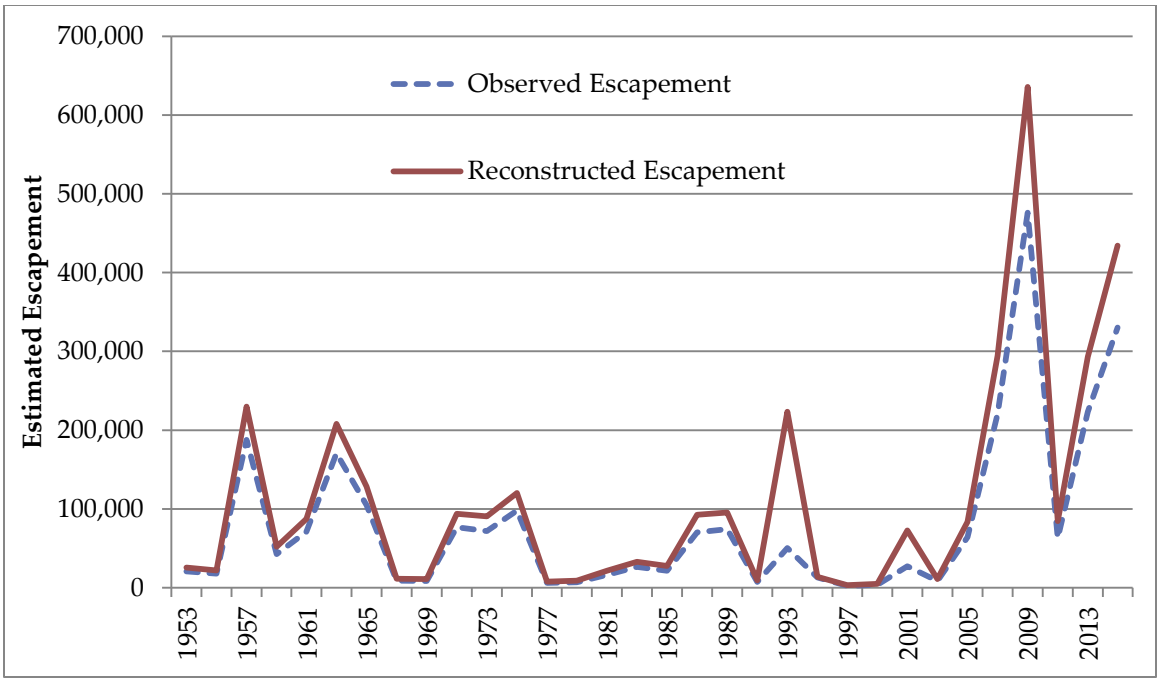

Figure 8. Observed and Reconstructed Escapement Time Series for the East Vancouver Island-Johnstone Strait Odd Year Pink Salmon CU

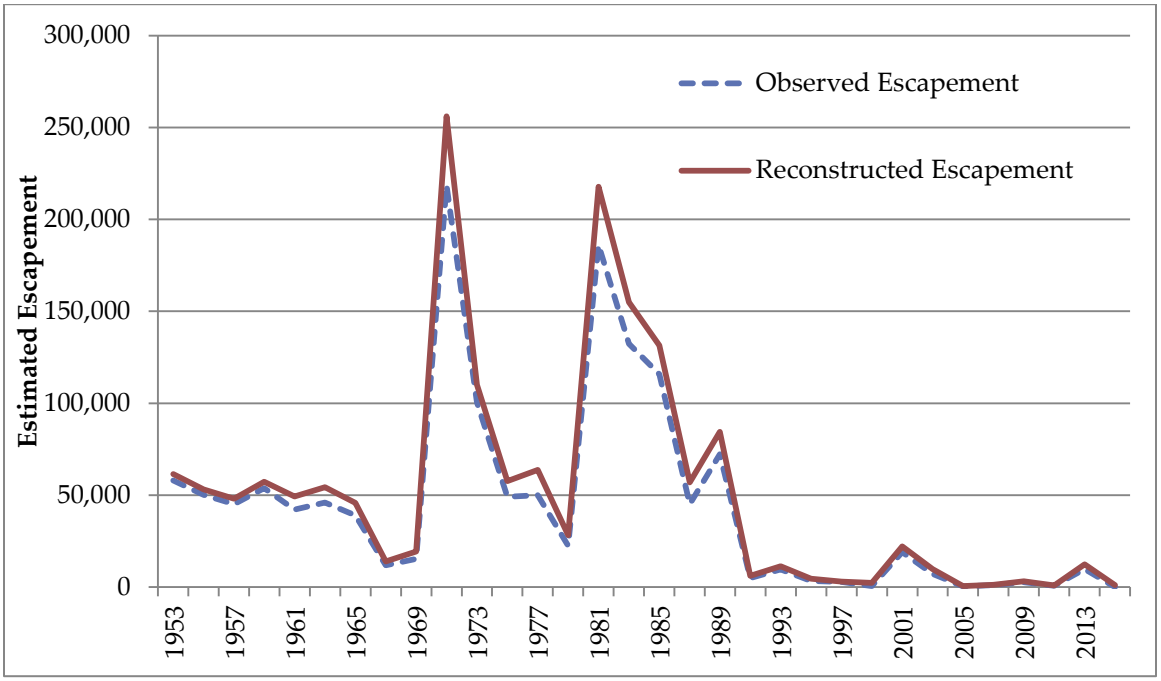

Figure 9. Observed and Reconstructed Escapement Time Series for the Homathko-Klinaklini Odd Year Pink Salmon CU

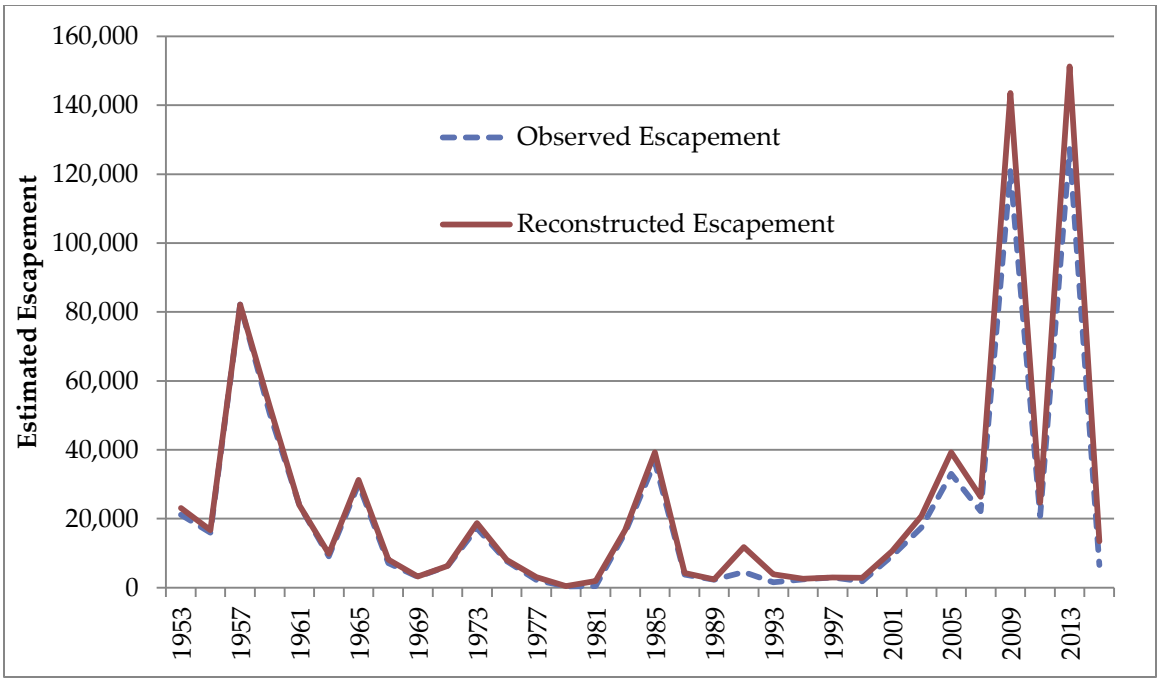

Figure 10. Observed and Reconstructed Escapement Time Series for the Nahwitti Odd Year Pink Salmon CU

Catch Data Assignment to CU

Even Year:

During even years the contribution of Fraser and US stocks is negligible, all catch of pink was assumed to be of ISC origin (negligible abundance from the Fraser and U.S. Stocks). Catch was compiled from various sources with resolution to Fishing area, gear, and time period (Table 3). Catch was then apportioned to the various CU's based on the following:

- CU escapements were broken down by management area
- The proportion of each CU to the total ISC escapement was determined
- The proportion of each CU escapement by management area was determined
- Catch data was summarized by management area
- Fish were assumed to move in a North to South direction (if fish were caught in a management area to the South of a given CU there were not apportioned to that CU)
- Catch by management area was distributed to all CUs that were assumed to migrate through that management area based on their CU escapement proportions by management area.

The distribution of pink catch by CU (by population area) has been provided in Table 4.

Odd Year:

For odd-year returns, the first step uses Genetic Stock Identification (GSI). GSI analyzes tissue samples collected from pink salmon caught in mixed-stock fisheries to estimate the contribution of Fraser River pink salmon (White 1996). Canada Inner South Coast (non-Fraser) and

Washington pink salmon stocks are also often present in the stock contribution estimates, although generally in lower proportions than Fraser stocks. GSI sampling is conducted in odd-year Canadian (south of Cape Caution) and Washington pink salmon fisheries. From 1989 to 2005 protein electrophoretic analysis of allozymes was employed and starting in 2007 microsatellite DNA analysis has been conducted. All catch of odd year pinks prior to 1989 were compiled from a variety of Post Season reports (e.g. Anderson et al., 1979) ISC catch by year fishery and area are provided in Table 5. Odd year catch was then apportioned to the various odd years CU's following a similar approach as was employed with the even year catch detailed above. The resolution of that catch data prior to 1989 is not to the same level as the more recent data, so catch data prior to 1989 is rolled up for the entire ISC area and then apportioned to CU based on escapement levels. The main issue there would be assignment of catch to a CU that may be in a more northerly area than where the fishery occurred. This may result in over estimates of exploitation of some of these CUs. It is felt however that this data is still useful in looking at the trend in abundance over time. Further review of variation in CU migration timing should be made to improve the current reconstructions. It is hoped that improved GSI work the Pacific Salmon Commission is focusing on for pink salmon during odd years will help in that component.

Table 3. Estimated Catch of Even Year ISC Pink Salmon by Year, Fishery and Area.

Year	Area 11-12					Area 13				Other Areas			Total Pink Catch
	Commercial	Commercial (Terminal)	FSC	Sport	Total Area 11-12	Commercial	FSC	Sport	Total Area 13	FSC	Sport	Total Others	
1954	351,561				351,561	48,456			48,456				400,017
1956	800,307				800,307	119,739			119,739				920,046
1958	1,173,422				1,173,422	197,719			197,719				1,371,141
1960	315,073				315,073	32,325			32,325				347,398
1962	716,513				716,513	40,398			40,398				756,911
1964	785,919				785,919	75,030			75,030				860,949
1966	3,234,243				3,234,243	212,912			212,912				3,447,155
1968	3,488,351				3,488,351	229,447			229,447				3,717,798
1970	2,241,673				2,241,673	184,798			184,798				2,426,471
1972	699,290				699,290	83,449			83,449				782,739
1974	1,416,942				1,416,942	173,820			173,820				1,590,762
1976	3,774,412				3,774,412	117,082			117,082				3,891,494
1978	1,255,706				1,255,706	94,577			94,577				1,350,283
1980	1,131,498				1,131,498	70,531			70,531				1,202,029
1982	172,147				172,147	19,208		1,786	20,994		1,041	1,041	194,182
1984	204,872				204,872	24,361		6,413	30,774		3,828	3,828	239,474
1986	496,370				496,370	72,958		2,136	75,094		948	948	572,412
1988	648,640	272,019			920,659	65,144		4,739	69,883		3,881	3,881	994,423
1990	274,520	3,451,121	1,563		3,727,204	314,811		8,997	323,808		2,352	2,352	4,053,364
1992	818,063	175,719	2,522		996,304	203,489	3,058	16,762	223,309	93	2,128	2,221	1,221,834
1994	194,965		50		195,015	25,858		15,846	41,704	1,517	2,333	3,850	240,569
1996	47,601		1,094		48,695	20,719	1,002	4,189	25,910		3,341	3,341	77,946
1998	71,778		18,332		90,110	24,410	150	4,522	29,082	1	488	489	119,681
2000	262,404	861,042	4,699	23,520	1,151,665	290,479	5,784	9,518	305,781	36	18	54	1,457,500
2002	105,651		1,088	4,815	111,554	25,223	1,253	11,002	37,478	95	625	720	149,752
2004	80,268		409	12,199	92,876	16,457	284	3,981	20,722		201	201	113,799
2006	31,664		122	15,343	47,129	11,201	510	1,560	13,271		17	17	60,416
2008	6,811		2,675	4,944	14,430	945	1,074	825	2,844	7	10	17	17,291
2010	171,099		3,812	3,500	178,411	25,251	1,688	1,214	28,153	2	484	486	207,050
2012	140		5,652	10,875	16,667	132	2,003	4,754	6,889	17	323	340	23,896
2014	485,048		13,630	11,045	509,723	55,221	4,211	10,609	70,041	0	1,850	1,850	581,614
2016	19		243	2,451	2,713	0		1,946	1,946	19	286	305	4,964

FSC=Food Social and Ceremonial

Table 4. Pink salmon catch distribution to even year CUs by Area (1954-2016)

CUs by Area	Southern Fjords (even) Populations by Area			Georgia Strait (even) Populations by Area										Total Catch
Year	Area 12	Area 13	Total	Area 13	Area 14	Area 15	Area 16	Area 17	Area 18	Area 19	Area 20	Area 28	Total	
1954	115,682	39,025	154,707	151,016	82,927	763	2,220	2,030	-	-	6,263	91	245,310	400,017
1956	478,704	183,845	662,548	158,519	87,047	801	2,330	2,131	-	-	6,574	95	257,498	920,046
1958	670,030	261,158	931,188	270,841	148,727	1,368	3,981	3,641	-	-	11,233	163	439,953	1,371,141
1960	225,422	85,831	311,253	22,251	12,219	112	327	299	-	-	923	13	36,145	347,398
1962	539,294	185,326	724,620	19,879	10,916	100	292	267	-	-	824	12	32,291	756,911
1964	586,373	225,799	812,172	30,028	16,489	152	441	404	-	-	1,245	18	48,777	860,949
1966	2,468,272	882,755	3,351,028	59,177	32,496	299	870	795	-	-	2,454	36	96,127	3,447,155
1968	2,666,908	954,809	3,621,718	59,148	32,480	299	869	795	-	-	2,453	36	96,080	3,717,798
1970	1,717,593	650,164	2,367,756	36,146	19,849	183	531	486	-	-	1,499	22	58,715	2,426,471
1972	527,535	219,361	746,896	22,065	12,117	111	324	297	-	-	915	13	35,843	782,739
1974	1,080,757	458,831	1,539,588	31,503	17,299	159	463	423	-	-	1,307	19	51,174	1,590,762
1976	2,858,071	902,034	3,760,105	80,885	44,416	409	1,189	1,087	-	-	3,355	49	131,389	3,891,494
1978	961,226	355,395	1,316,621	20,723	11,380	105	305	279	-	-	859	12	33,662	1,350,283
1980	858,693	302,436	1,161,129	25,179	13,826	127	370	338	-	-	1,044	15	40,900	1,202,029
1982	133,221	57,390	190,612	1,557	1,771	16	47	43	-	-	134	2	3,570	194,182
1984	157,939	73,182	231,121	2,786	4,896	45	131	120	-	-	370	5	8,353	239,474
1986	307,141	120,064	427,206	88,807	49,600	456	1,328	1,214	-	-	3,746	54	145,206	572,412
1988	444,516	166,987	611,503	65,883	39,592	364	1,060	969	-	-	2,990	43	110,902	722,404
1990	174,677	204,979	379,656	135,579	76,519	704	2,048	1,873	-	-	5,779	84	222,586	602,243
1992	552,855	283,766	836,621	127,600	72,022	663	1,928	1,763	-	-	5,440	79	209,493	1,046,115
1994	139,010	67,871	206,881	18,368	13,473	124	361	330	-	-	1,018	15	33,688	240,569
1996	33,969	26,232	60,201	8,867	7,807	72	209	191	-	-	590	9	17,745	77,946
1998	67,203	42,683	109,886	5,729	3,576	33	96	88	-	-	270	4	9,795	119,681
2000	218,597	320,890	539,488	35,038	19,288	177	516	472	-	-	1,457	21	56,970	596,458
2002	69,014	36,329	105,343	26,895	15,402	142	412	377	-	-	1,163	17	44,408	149,752
2004	69,954	37,274	107,228	3,921	2,331	21	62	57	-	-	176	3	6,571	113,799
2006	33,907	19,013	52,921	4,604	2,543	23	68	62	-	-	192	3	7,495	60,416
2008	8,741	3,669	12,410	2,995	1,659	15	44	41	-	-	125	2	4,881	17,291
2010	76,585	27,358	103,944	63,174	35,118	323	940	860	-	-	2,652	38	103,106	207,050
2012	10,597	6,332	16,929	4,080	2,539	23	68	62	-	-	192	3	6,967	23,896
2014	251,458	89,456	340,914	147,039	82,371	758	2,205	2,016	-	-	6,221	90	240,700	581,614
2016	1,859	1,707	3,566	673	638	6	17	16	-	-	48	1	1,398	4,964

Table 5. Estimated Catch of Odd Year ISC Pink Salmon by Year, Fishery and Area.

Year	Area 11-12				Area 13				Other Canadian Areas						US Areas			Total
	Comm.	FSC	Sport	Test Fish	Comm.	FSC	Sport	Test Fish	Area 29 Comm.	WCVI J de F Comm.	WCVI J de F FSC	WCVI J de F Sport	WCVI J de F Test Fish	North Coast	US Comm.	US Sport	US Test Fish	
2015	0	1,155	TBD	15,241	0	8,168	TBD	8,568			0	TBD	11,888		199,820	TBD	11,717	256,556
2013	75,027	17,457	9,342	66,810	10,132	17,689	16,689	62,535	38,247		312	23,406	17,404		423,904	7,880	17,346	804,181
2011	417,261	9,450	5,114	1,411	9,884	7,447	9,136	250			38	12,332	1,095		414,262	4,429	1,279	893,388
2009	119,115	2,401	8,665	1,389	86,784	4,849	15,478	1,456	4,923		5	4,799	1,752		313,327	5,244	827	571,014
2007		1,140	6,269	1,382	129	1,070	4,058	2,866				16,089	3,070		35,618	3,069	73	74,833
2005	1,775	28,866	3,561	24,820		10,527	5,524	3,760				2,471	790		8,200	2,408	60	92,762
2003	220,916		2,791	4,672	25,557		3,446	1,740		282		8,161	2,651		21,535	2,924		294,676
2001	140,732	7,352	3,713	8,085	66,450	11,378	18,776	7,887		443	19	1,131	913		30,987	3,776		301,642
1999	1,599	1,614	10,774	1,004	297	1,390	9,384	770		176	197	292	945		424	934		29,799
1997	203,599	980	910	1,326	78,705	306	793	235		12,197	5	3,485	626	,577	96,393	1,025		408,159
1995	125,996	537	1,322	2,794	29,663	1,328	1,151	2,634		95,799	91	8,718	2,095	122,678	71,369	2,349	4	468,528
1993	629,330		3,544	610	89,417		3,087			43,431		3,895	1,518	101,627	103,279	2,200	16	981,953
1991	257,442		2,418	1,003	132,324		2,106			152,634		11,136	1,867	222,906	151,987	3,407	117	939,346
1989	754,387		2,239	1,153	181,711		1,950			287,690		8,002	2,470	181,254	125,628	3,525	350	1,550,360
1987																		477,000
1985																		1,026,100
1983																		1,236,000
1981																		885,400
1979																		424,300
1977																		487,877
1975																		689,791
1973																		1,019,992
1971																		663,871
1969																		118,103
1967																		746,782
1965																		425,989
1963																		1,992,112
1961																		1,818,443
1959																		1,508,726

*Comm.=Commercial, FSC=Food Social and Ceremonial, TBD=to be determined

Table 6. Pink salmon catch distribution to odd year CUs by Area (1959-2015)

CUs by Area	Southern Fjords		Georgia Strait						East Howe Sound-Burrard Inlet		East Vancouver Island		Homathko-Klinaklini		Nahwitti	Total
Year	Area 12	Area 13	Area 13	Area 14	Area 15	Area 16	Area 17	Area 28	Area 16	Area 28	Area 12	Area 13	Area 12	Area 13	Area 12	
1959	373,696		589,824						320,097		72,264		79,582		73,263	1,508,726
1961	392,324		592,757						595,492		129,277		73,077		35,516	1,818,443
1963	275,866		474,294						962,159		213,863		55,806		10,123	1,992,112
1965	170,001		79,368						49,771		79,220		28,312		19,317	425,989
1967	448,845		172,847						60,620		21,753		26,905		15,812	746,782
1969	56,745		34,227						10,770		5,283		9,504		1,574	118,103
1971	326,305		81,525						27,331		60,309		164,355		4,046	663,871
1973	641,135		117,423						84,225		73,105		88,968		15,136	1,019,992
1975	528,093		64,001						19,523		50,520		24,268		3,386	689,791
1977	219,350		126,606						36,643		10,670		90,287		4,321	487,877
1979	254,369		87,106						33,779		11,536		36,929		580	424,300
1981	589,361		84,824						36,414		15,520		157,906		1,374	885,400
1983	1,025,779		35,962						20,896		24,692		116,175		12,496	1,236,000
1985	747,604		67,177						11,543		27,734		132,459		39,583	1,026,100
1987	79,596		237,325						39,466		72,642		44,656		3,314	477,000
1989	267,953	150,684	152,940	93,253	48,883	107,981	6,934	53,803	53	286,682	113,167	118,323	140,393	5,211	4,101	1,550,360
1991	75,343	37,078	186,757	113,873	59,692	131,857	8,467	65,700	44	237,025	5,024	4,597	4,652	151	9,087	939,346
1993	233,708	88,216	61,910	37,749	19,788	43,711	2,807	21,780	48	259,494	118,288	83,015	8,328	207	2,904	981,953
1995	130,477	86,251	52,547	32,040	16,795	37,100	2,382	18,486	14	74,450	6,077	7,469	2,732	119	1,587	468,528
1997	124,419	91,243	61,446	37,466	19,639	43,383	2,786	21,616	0	1,718	890	1,213	1,151	56	1,135	408,159
1999	5,658	3,339	5,513	3,361	1,762	3,892	250	1,939	1	3,957	34	37	23	1	30	29,799
2001	76,433	48,675	44,331	27,030	14,169	31,300	2,010	15,595	6	33,421	3,055	3,618	1,307	55	634	301,642
2003	40,269	12,524	61,331	37,396	19,603	43,302	2,780	21,576	8	45,434	1,872	1,082	2,355	48	5,096	294,676
2005	11,818	4,820	17,352	10,580	5,546	12,251	787	6,104	3	16,366	2,931	2,223	21	1	1,958	92,762
2007	2,049	6,606	15,310	9,335	4,894	10,810	694	5,386	2	8,770	1,540	9,231	9	2	196	74,833
2009	27,403	38,353	140,818	85,862	45,008	99,422	6,384	49,538	3	13,787	15,140	39,398	104	10	4,861	566,091
2011	71,019	38,581	219,701	133,959	70,221	155,117	9,960	77,289	12	62,526	22,521	22,747	337	12	9,386	893,388
2013	18,466	31,147	310,984	189,618	99,397	219,566	14,099	109,402	3	18,604	7,508	23,545	442	49	5,504	1,048,334
2015	1,244	5,130	71,730	43,736	22,926	50,644	3,252	25,234	4	22,957	1,113	8,533	3	1	49	256,556

Total Stock Determination

Total stock by year and CU was determined by combining the reconstructed escapement and the apportioned catch. Yearly exploitation was derived by dividing the catch assigned to that CU by the total stock of that CU. This data is presented in Table 8 and Table 9.

Sustainable Escapement Goal Development

In this section, we present revised benchmarks for both even and odd year pink CUs within the ISC area. The applied technique, also used in Chum populations in BC and Alaska with similar escapement data quality as the ISC pink salmon, focuses on percentiles of the escapement time series to establish benchmarks to assess trends in status (.(Eggers, 2008; Van Will 2009). This fairly simple approach, known as Sustainable Escapement Goals or SEGs, identifies the 25th and 75th percentile of the escapement time series as the lower and upper SEGs. This approach assumes that if populations have recovered from low levels in the past they will again as long as conditions remain similar to those encountered in the past. These SEGs represent interim fishery reference points similarly to what was presented in the Alaskan and ISC Chum Assessment reports under MSC. Under the Fisheries & Oceans Canada's Wild Salmon Policy, the further development of benchmarks for chum salmon will be undertaken.

Upper and Lower SEGs for the ISC pink stocks were calculated based on the reconstructed escapement time series and identified for each CU (Table 7). In some instances, such as the Georgia Strait even year Pink CU where significant enhancement began later in the time series and has been maintained, the Lower and Upper SEGs are calculated not including the pre-enhancement years. These were then compared to the expanded escapement time series to evaluate status relative to those SEGs (Figure 11, Figure 12, Figure 13, Figure 14, Figure 15, Figure 16, Figure 17 and Figure 18)

Table 7. Sustainable Escapement Goals for ISC Pink CUs

	Conservation Units							
Benchmark	**Southern Fjords (even)**	**Georgia Strait (even)***	**Southern Fjords (odd)**	**Georgia Strait (odd)***	**East Howe Sound-Burrard Inlet (odd)**	**East Vancouver Island (odd)**	**Homathko-Klinaklini (odd)**	**Nahwitti**
Upper SEG (75th percentile)	1,737,300	501,820	657,464	800,121	158,755	126,216	60,510	25,954
Lower SEG (25th percentile)	602,979	109,879	208,276	149,934	36,850	11,842	4,867	3,368

*SEGs have been revised to only include years with continued hatchery supplementation.

ISC Pink CU Abundance and Exploitation Trends

Even Years

The overall time series of abundance for the two even year ISC CUs are provided in Figure 11 and Figure 12. Exploitation on both of these CUS has decline dramatically since the early 80s. Prior to this exploitations average around 60% compared to less than 10% over the last 5 generations (Figure 11, Figure 12). This reduction in exploitation is attributed to reduction and compression of Fraser directed Sockeye fisheries and a very cautious management approach to the Mainland Inlet Pink terminal fisheries since the decline observed in 2002. Spawning escapements in both CUs have varied over time but as expected with reduced harvest and increase supplementation (in the Georgia Strait CU), spawning abundance tend to be larger since the mid-80s.

Southern Fjords

The Southern Fjords CU is the largest producer of even year pinks in the ISC area (Figure 11). Spawning escapements began to increase in the mid-80s until the 2000 return when the CU encountered its largest recorded escapement. There was a significant decline in abundance the subsequent brood year (2002) with a continued low productivity period until increases in abundance since 2008. For a majority of the time series (1954-2016) escapement abundances have been within the SEG range (between the 25 percentile and the 75 percentile of the escapement time series). Since the mid 80's till the early 2000s, the abundance tended to be well above the upper SEG. The escapements moved back to within the SEG range in 2002 with 2008 dipping below the lower SEG. Last 3 generations have seen the spawning escapements climb back into the SEG range and move above the Upper SEG in 2012 and 2014. Another drop in abundance occurred in 2016 just above the lower SEG. There is a significant amount of variability in the escapements over time.

Georgia Strait

The Georgia Strait CU historically was not a large contributor to the ISC pink even year population (Figure 12). This changed in the mid-80s with a combination of reduced exploitation and increased hatchery supplementation and various Georgia Strait facilities (i.e. Quinsam Hatchery). Abundances since the mid-80s have continued to be well above past historic returns except for a period of lower productivity from 2004-2006 as seen in the other even year CU. Similar to the Southern Fjords, abundance has improved since 2008. Revised upper and lower SEGs were developed for this CU based on the enhancement years since 1986 (Figure 12). Since 1986, most of the escapements have been within the SEG range. A declining trend since the late 80s was observed, with abundances in 04-06 dropping below the lower SEG. Recovery of the populations has been observed in recent years since 2008 escapements with the last 3 cycles well above the Upper SEG. Similar to the Southern Fjords abundances ion 2016 were low indicating a regional decline in pink productivity from the 2014 brood year (2015 outmigration year) Large variability in returns is evident in this CU even with the significant hatchery supplementation. The significant increase production out of the Quinsam River is

attributed to the increase in access to pink spawners to upper watershed with the opening of further spawning grounds in recent years.

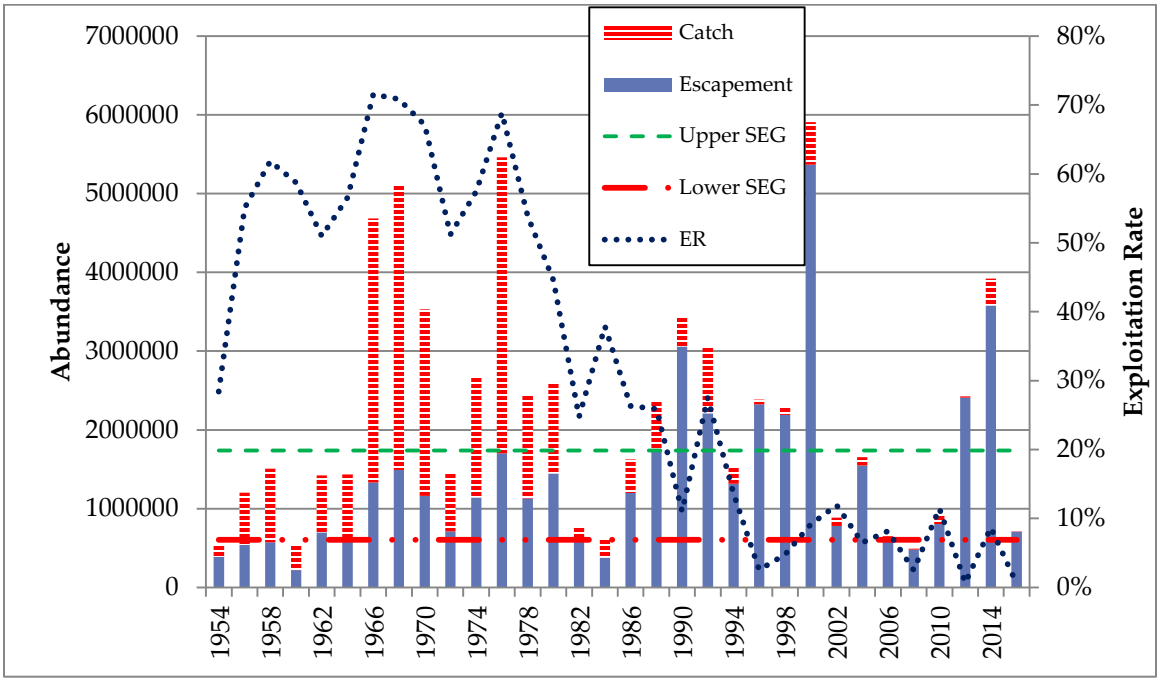

Figure 11. Trend in abundance of the Southern Fjords even year Pink CU

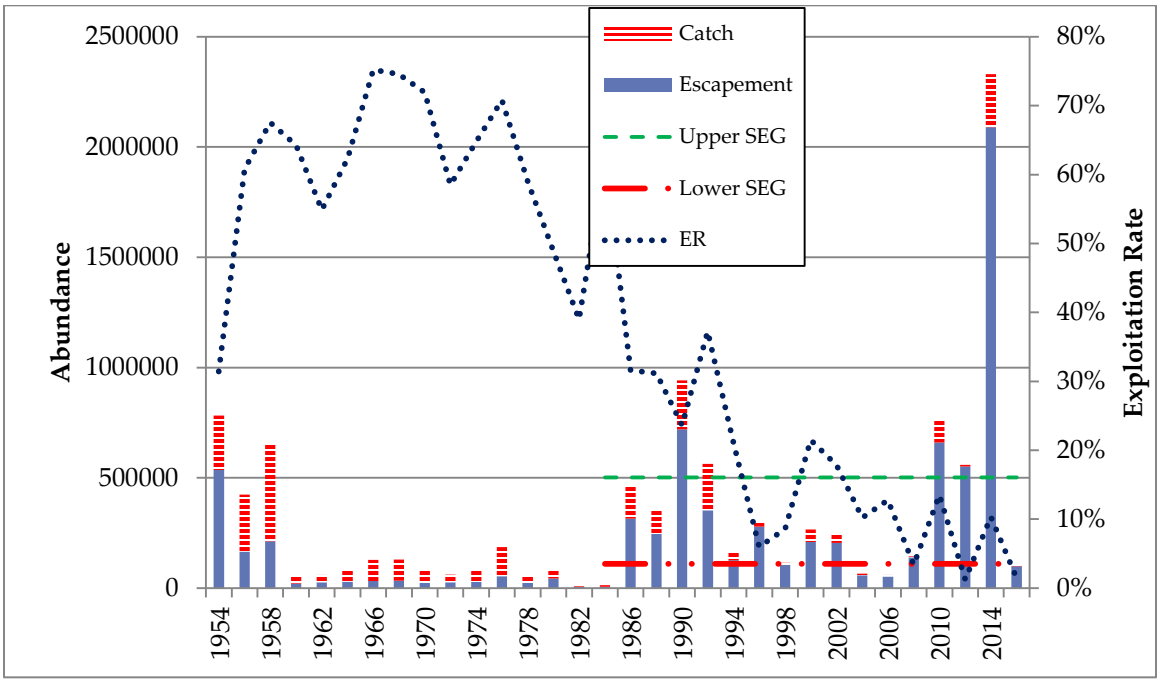

Figure 12. Trend in abundance of the Georgia Strait even year Pink CU

Odd Years

There appears to be much larger variation in the odd year populations within the ISC area. Compared to the 2 CUs of even year pinks, there are 6 identified CUs for the odd cycle years. Exploitation of these stocks historically has averaged around 50% but has declined since the late 1990's to 10-20% in the last 5 generations. This reduction in exploitation is attributed to constraints in other fisheries which harvest ISC odd year pinks as a by-catch (i.e. Fraser Directed Sockeye and Pink fisheries) and a more cautious management approach to terminal fisheries in areas such as the Mainland Inlets since the large stock decline observed in 2003.

Southern Fjords

Similar to the even year Southern Fjords, this CU is the largest producer of pinks during the odd years within the ISC area (Figure 13). This CU has encountered highly variable returns throughout the time series with the highest escapement on record in 2001. The subsequent decline in abundance the following brood return (2003) has been followed with a steady improving trend with another strong resurgence in 2009. Returns over the next 3 cycles (2011-2015) have all be within the SEG range but extremely variable.

Georgia Strait

This CU has undergone a significant shift in abundance during the mid-80s with increase enhanced supplementation and a reduction in exploitation (Figure 14). Populations in this CU have seen a steady improving trend since that time with strong returns in the last 4 cycle years (2009-2015)

East Howe Sound-Burrard Inlet

The time series of this CU is populated with very strong returns in the early years (early 60s) then with lower but fairly stable abundance since (Figure 15). The Exploitation pattern follows a similar trend as that of the Georgia Strait CU with a significant drop in exploitation in the late 90s. The strong returns in 2009 that were seen in most other ISC CUs were not evident in this area. Most of the escapement years have been within the SEG range and recent years have not seen anything below the lower SEG. Keep in mind coverage in this area is poor and the strength observed in2015 is based on a large expansion due to limited coverage.

East Vancouver Island

High variability in return abundance is very apparent in this CU (Figure 16). Since the extremely low return in 2003, this CU has undergone and extremely steady improving trend in abundance with the largest recorded escapement occurring in 2009. 4 of the last 5 return years well above the upper SEG (2007, 2009, 2013 and 2015).

Homathko-Klinaklini

This CU is the likely the least monitored CU for pinks within the ISC area. Most systems are highly glacial and difficult to enumerate for pink abundance. The time series of abundance demonstrates a significant decline in the early 1990's (Figure 17). Similar to the Howe Sound-Burrard Inlet CU, no

strong signal in the escapement was see in 2009. This CU, in recent years, tends to be at the hovering around the lower SEG and doesn't seem to follow a similar pattern as many of the other CU surrounding it. Further review of this dataset is required to determine if that decline is real or simply an artifact of the data.

Nahwitti

This most Northern CU is smallest producer of pink salmon in the ISC area. The time series of abundance includes a period of low abundance from the late 60s through the early 2000s (Figure 18). An improving trend is evident since the early 2000s with escapement levels returning to that seen in the 60s. The escapement of pink to this CU in 2013 was the largest on record followed by a drop in abundance in the 2015 return. Escapements have improved since lows in the late 90's to be within or well above the SEG range.

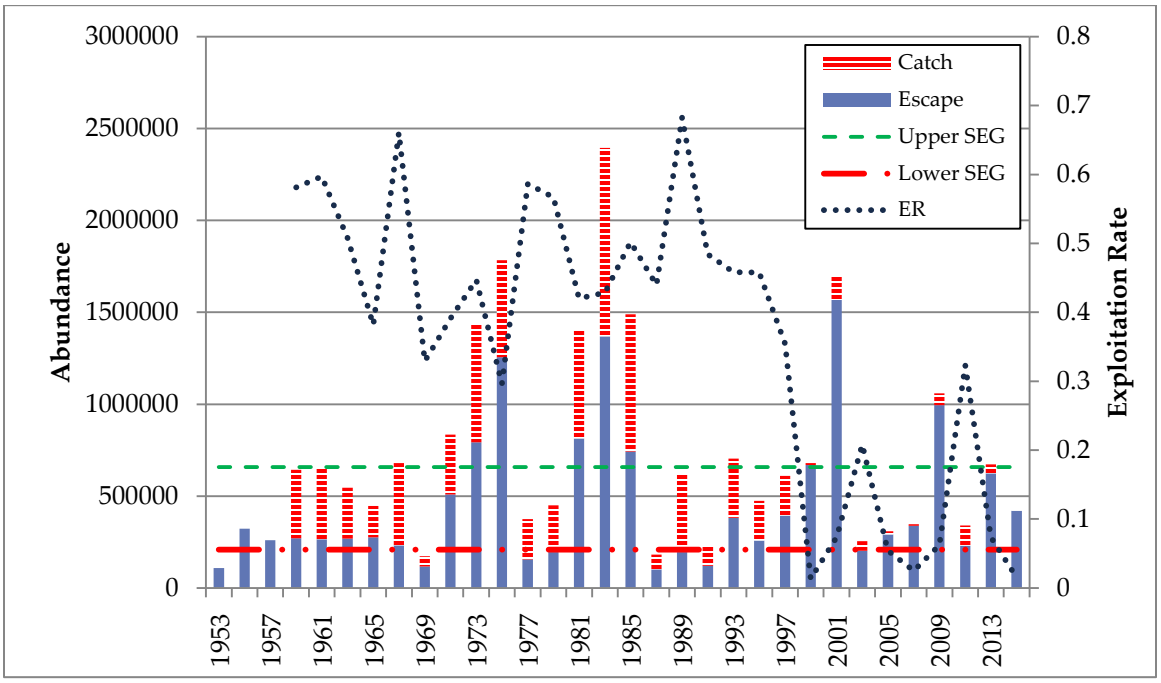

Figure 13. Trend in abundance of the Southern Fjords odd year Pink CU.

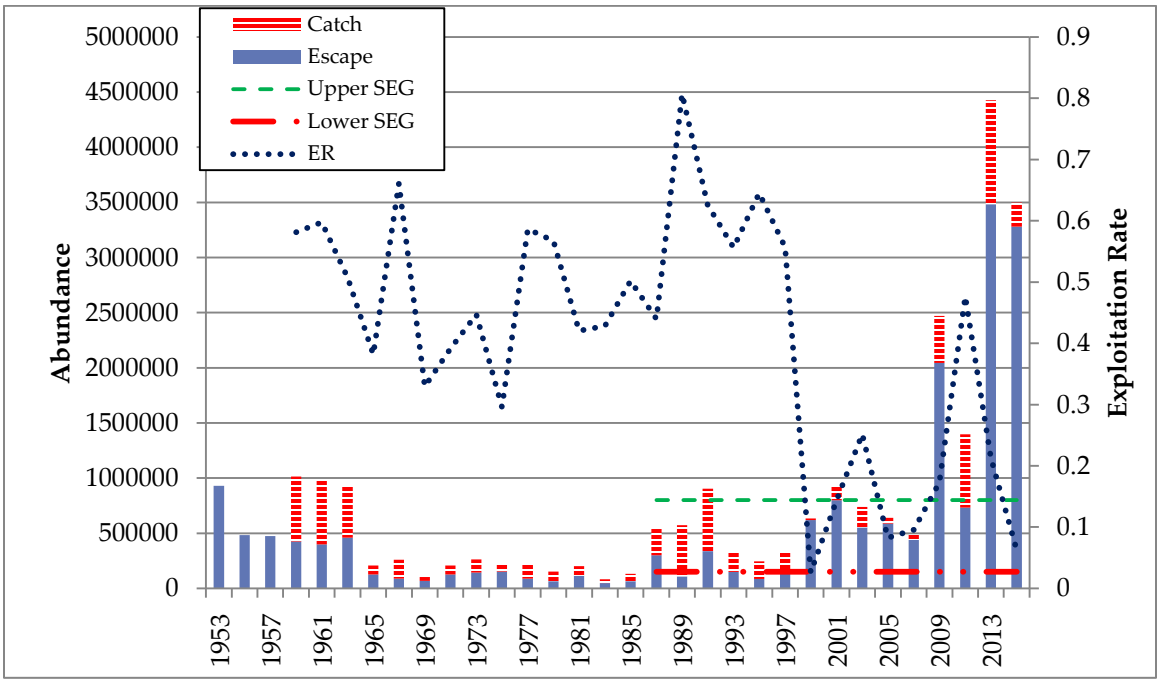

Figure 14. Trend in abundance of the Georgia Strait odd year Pink CU.

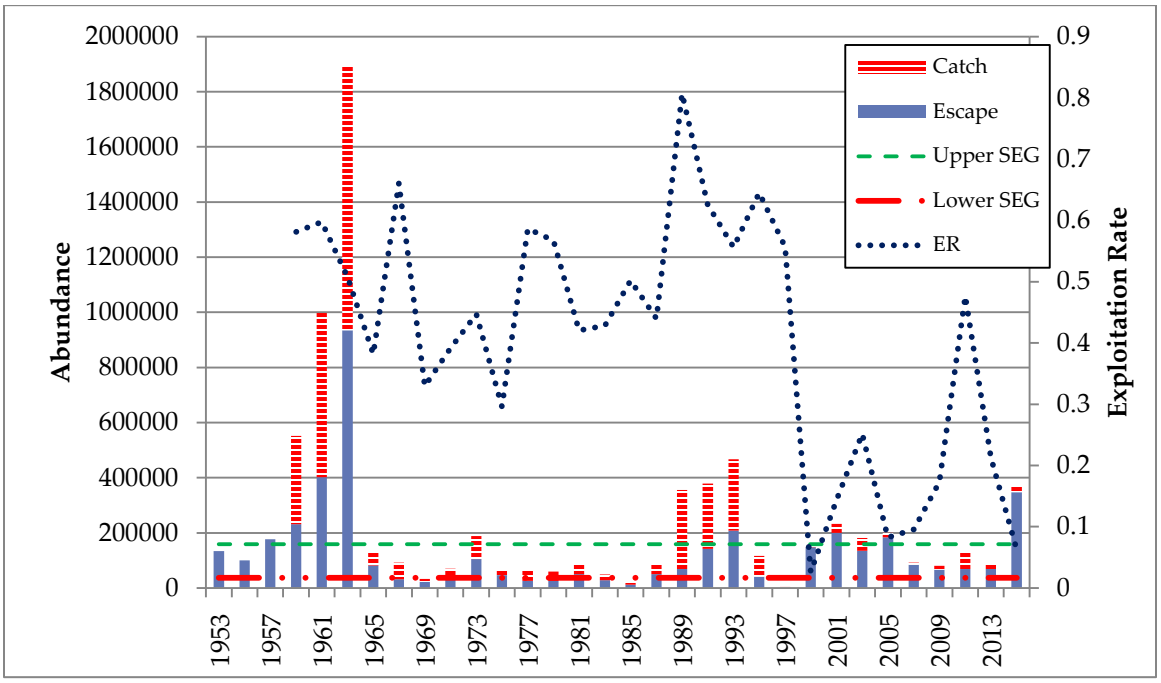

Figure 15. Trend in abundance of the East Howe Sound-Burrard Inlet odd year Pink CU.

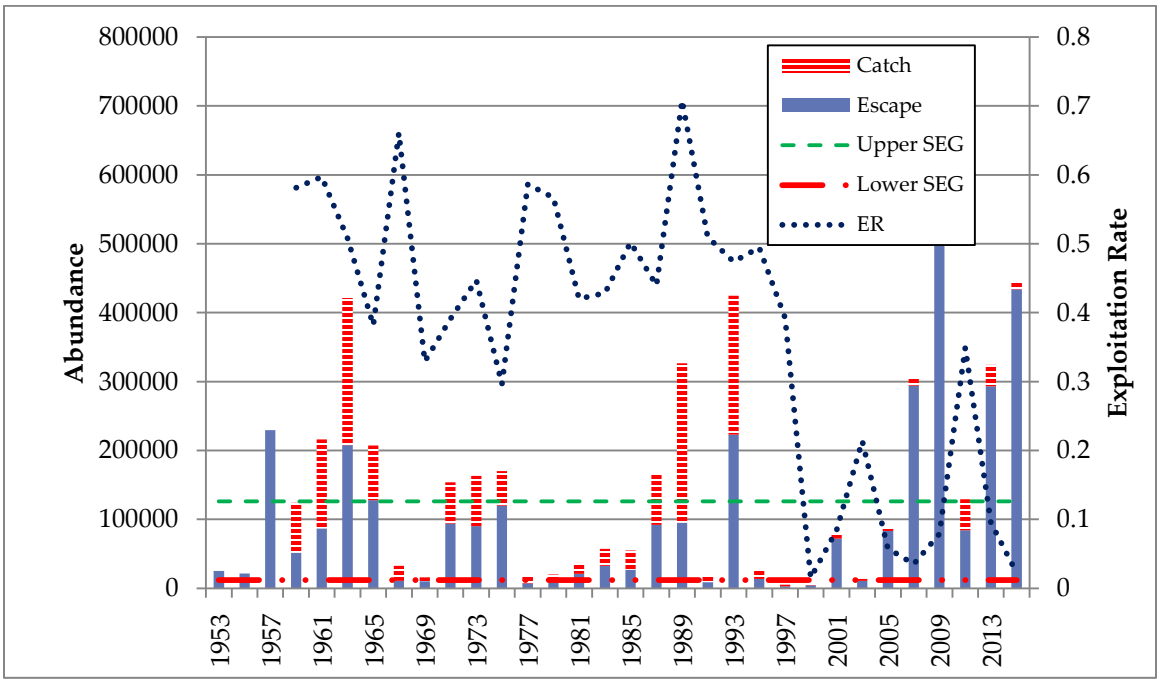

Figure 16. Trend in abundance of the East Vancouver Island odd year Pink CU.

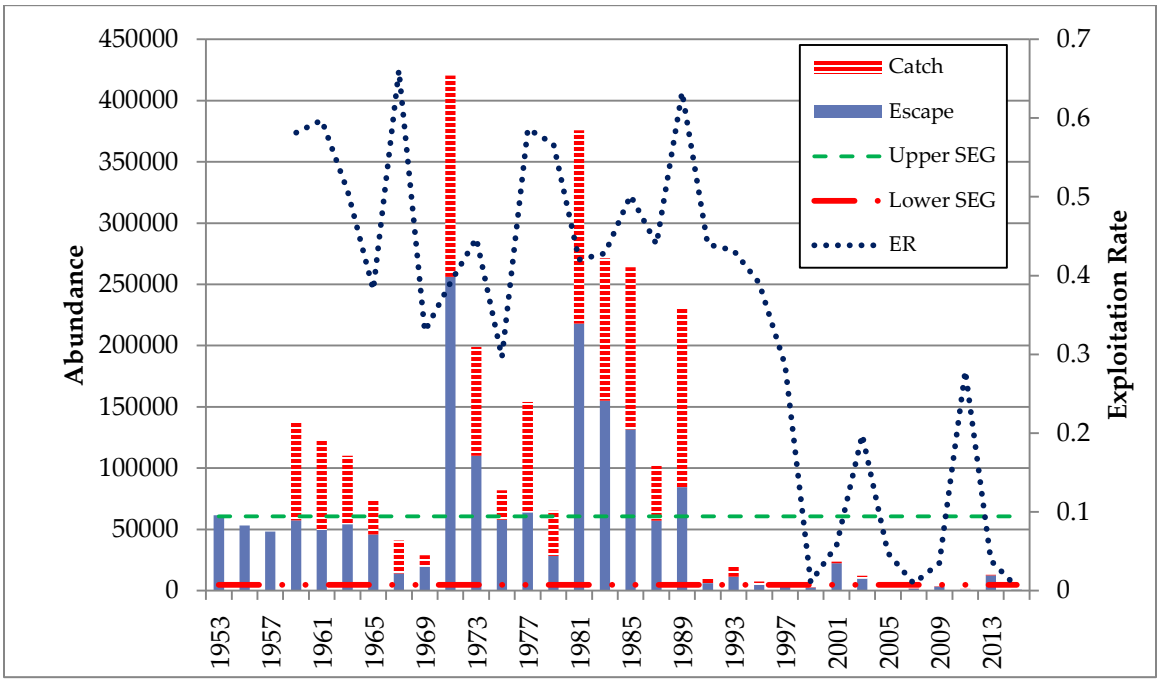

Figure 17. Trend in abundance of the Homathko-Klinaklini odd year Pink CU.

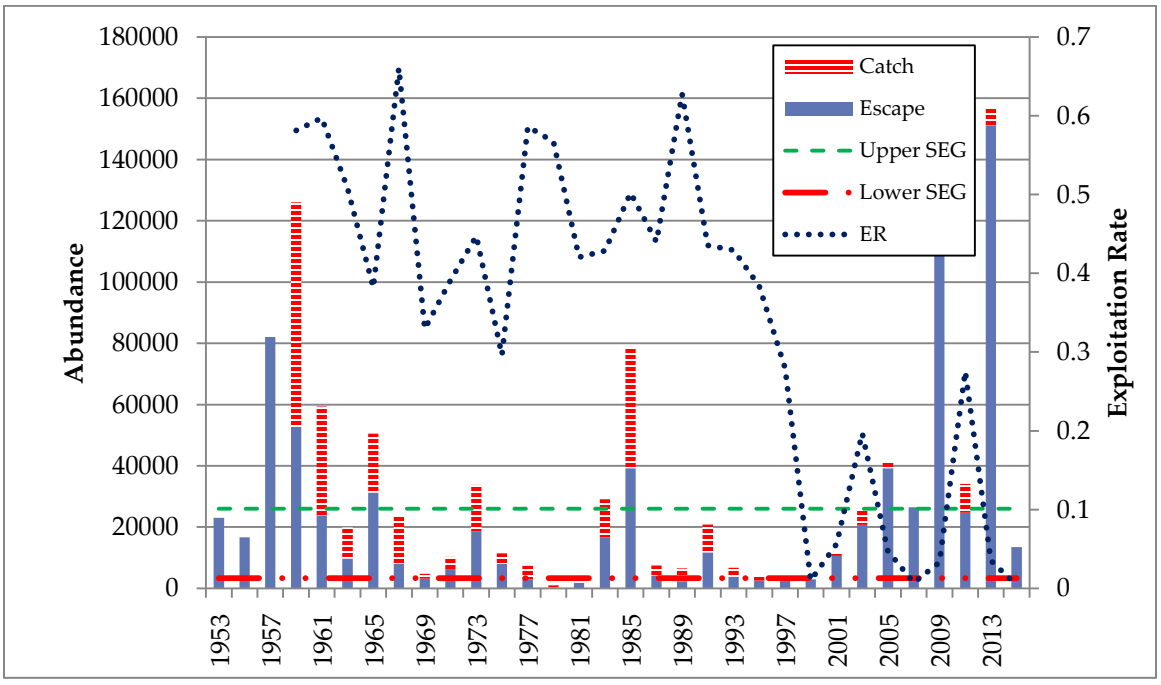

Figure 18. Trend in abundance of the Nahwitti odd year Pink CU.

Table 8. ISC Even Year Pink Escapement, Catch, Total Stock and Exploitation by Year.

Year	Southern Fjords (even)				Georgia Strait (even)			
	Reconstructed Escapement	Apportioned Catch	Total Stock	Estimated Exploitation	Reconstructed Escapement	Apportioned Catch	Total Stock	Estimated Exploitation
1954	389,830	154,707	544,537	28%	535,824	245,310	781,134	31%
1956	541,159	662,548	1,203,707	55%	165,736	257,498	423,233	61%
1958	574,196	931,188	1,505,384	62%	211,510	439,953	651,463	68%
1960	218,554	311,253	529,807	59%	20,125	36,145	56,270	64%
1962	697,069	724,620	1,421,689	51%	26,558	32,291	58,849	55%
1964	622,955	812,172	1,435,127	57%	29,425	48,777	78,202	62%
1966	1,331,478	3,351,028	4,682,506	72%	31,704	96,127	127,831	75%
1968	1,489,447	3,621,718	5,111,165	71%	32,773	96,080	128,853	75%
1970	1,161,461	2,367,756	3,529,217	67%	22,935	58,715	81,650	72%
1972	711,634	746,896	1,458,531	51%	25,426	35,843	61,268	59%
1974	1,139,438	1,539,588	2,679,026	57%	27,788	51,174	78,961	65%
1976	1,699,990	3,760,105	5,460,095	69%	54,144	131,389	185,533	71%
1978	1,130,452	1,316,621	2,447,073	54%	23,413	33,662	57,075	59%
1980	1,445,426	1,161,129	2,606,555	45%	42,742	40,900	83,643	49%
1982	579,890	190,612	770,501	25%	5,589	3,570	9,159	39%
1984	378,787	231,121	609,908	38%	5,122	8,353	13,475	62%
1986	1,196,814	427,206	1,624,020	26%	314,428	145,206	459,635	32%
1988	1,749,737	611,503	2,361,240	26%	245,203	110,902	356,105	31%
1990	3,059,604	379,656	3,439,261	11%	718,802	222,586	941,389	24%
1992	2,209,392	836,621	3,046,013	27%	352,877	209,493	562,370	37%
1994	1,315,430	206,881	1,522,311	14%	126,450	33,688	160,138	21%
1996	2,324,225	60,201	2,384,426	3%	279,054	17,745	296,799	6%
1998	2,189,060	109,886	2,298,947	5%	104,355	9,795	114,150	9%
2000	5,365,526	539,488	5,905,013	9%	208,094	56,970	265,064	21%
2002	779,346	105,343	884,689	12%	204,935	44,408	249,344	18%
2004	1,546,844	107,228	1,654,071	6%	57,802	6,571	64,373	10%
2006	596,321	52,921	649,242	8%	51,286	7,495	58,781	13%
2008	480,239	12,410	492,648	3%	139,224	4,881	144,106	3%
2010	803,846	103,944	907,789	11%	659,305	103,106	762,412	14%
2012	2,409,508	16,929	2,426,436	1%	551,467	6,967	558,434	1%
2014	3,579,638	340,914	3,920,551	9%	2,089,904	240,700	2,330,605	10%
2016	704,628	3,566	708,194	1%	98,656	1,398	100,053	1%

Table 9. ISC Odd Year Pink Escapement, Catch, Total Stock and Exploitation by Year.

Year	Southern Fjords				Georgia Strait				East Howe Sound-Burrard Inlet			
	Escape	Catch	Total Stock	ER	Escape	Catch	Total Stock	ER	Escape	Catch	Total Stock	ER
1953	108,212				930,149				132,980			
1955	322,279				485,147				100,070			
1957	259,350				475,544				175,832			
1959	269,205	373,696	642,901	58%	424,900	589,824	1,014,724	58%	230,592	320,097	550,689	58%
1961	264,559	392,324	656,884	60%	399,719	592,757	992,476	60%	401,563	595,492	997,055	60%
1963	267,998	275,866	543,864	51%	460,765	474,294	935,060	51%	934,714	962,159	1,896,873	51%
1965	275,290	170,001	445,290	38%	128,525	79,368	207,893	38%	80,597	49,771	130,368	38%
1967	230,455	448,845	679,300	66%	88,746	172,847	261,593	66%	31,125	60,620	91,745	66%
1969	115,544	56,745	172,289	33%	69,694	34,227	103,921	33%	21,930	10,770	32,701	33%
1971	508,315	326,305	834,621	39%	126,999	81,525	208,523	39%	42,576	27,331	69,906	39%
1973	792,435	641,135	1,433,570	45%	145,133	117,423	262,557	45%	104,101	84,225	188,326	45%
1975	1,254,505	528,093	1,782,598	30%	152,036	64,001	216,037	30%	46,376	19,523	65,899	30%
1977	154,719	219,350	374,070	59%	89,302	126,606	215,908	59%	25,846	36,643	62,489	59%
1979	194,221	254,369	448,591	57%	66,509	87,106	153,616	57%	25,791	33,779	59,570	57%
1981	812,828	589,361	1,402,189	42%	116,987	84,824	201,811	42%	50,221	36,414	86,636	42%
1983	1,368,711	1,025,779	2,394,490	43%	47,984	35,962	83,946	43%	27,882	20,896	48,779	43%
1985	741,659	747,604	1,489,262	50%	66,643	67,177	133,820	50%	11,451	11,543	22,994	50%
1987	101,384	79,596	180,981	44%	302,288	237,325	539,613	44%	50,270	39,466	89,736	44%
1989	194,867	418,638	613,504	68%	110,912	463,793	574,705	81%	68,570	286,735	355,305	81%
1991	119,828	112,421	232,248	48%	338,459	566,345	904,804	63%	141,677	237,069	378,747	63%
1993	380,976	321,925	702,900	46%	149,934	187,745	337,679	56%	207,272	259,542	466,814	56%
1995	256,838	216,728	473,565	46%	87,748	159,351	247,099	64%	41,004	74,464	115,468	64%
1997	393,219	215,661	608,880	35%	148,496	186,335	334,831	56%	1,370	1,719	3,088	56%
1999	669,087	8,997	678,084	1%	619,443	16,718	636,161	3%	146,652	3,958	150,610	3%
2001	1,566,619	125,109	1,691,727	7%	800,121	134,436	934,557	14%	198,947	33,427	232,374	14%
2003	201,214	52,793	254,007	21%	552,573	185,987	738,561	25%	135,010	45,442	180,453	25%
2005	290,986	16,638	307,624	5%	587,403	52,620	640,024	8%	182,732	16,369	199,101	8%
2007	338,004	8,655	346,659	2%	439,262	46,429	485,691	10%	82,989	8,772	91,760	10%
2009	993,161	65,756	1,058,917	6%	2,044,859	427,032	2,471,891	17%	66,033	13,790	79,822	17%
2011	229,460	109,600	339,060	32%	732,743	666,248	1,398,991	48%	68,779	62,537	131,316	48%
2013	622,593	49,613	672,206	7%	3,485,946	943,066	4,429,012	21%	68,779	18,607	87,386	21%
2015	418,652	6,374	425,026	1%	3,282,797	217,522	3,500,318	6%	346,526	22,961	369,487	6%

Inner South Coast Pink Stock Reconstructions (1953-2016)*

Year	East Vancouver Island				Homathko-Klinaklini				Nahwitti			
	Escape	Catch	Total Stock	ER	Escape	Catch	Total Stock	ER	Escape	Catch	Total Stock	ER
1953	25,562				61,463				23,115			
1955	21,718				53,122				16,687			
1957	229,918				48,019				82,150			
1959	52,058	72,264	124,322	58%	57,330	79,582	136,912	58%	52,777	73,263	126,040	58%
1961	87,176	129,277	216,453	60%	49,279	73,077	122,355	60%	23,950	35,516	59,466	60%
1963	207,763	213,863	421,626	51%	54,214	55,806	110,020	51%	9,835	10,123	19,958	51%
1965	128,283	79,220	207,503	38%	45,846	28,312	74,158	38%	31,281	19,317	50,598	38%
1967	11,169	21,753	32,921	66%	13,814	26,905	40,718	66%	8,119	15,812	23,931	66%
1969	10,757	5,283	16,040	33%	19,352	9,504	28,856	33%	3,205	1,574	4,779	33%
1971	93,948	60,309	154,257	39%	256,032	164,355	420,387	39%	6,303	4,046	10,350	39%
1973	90,357	73,105	163,463	45%	109,963	88,968	198,930	45%	18,708	15,136	33,844	45%
1975	120,013	50,520	170,533	30%	57,649	24,268	81,917	30%	8,044	3,386	11,430	30%
1977	7,526	10,670	18,196	59%	63,684	90,287	153,971	59%	3,048	4,321	7,369	59%
1979	8,809	11,536	20,345	57%	28,197	36,929	65,126	57%	443	580	1,023	57%
1981	21,405	15,520	36,925	42%	217,779	157,906	375,685	42%	1,896	1,374	3,270	42%
1983	32,947	24,692	57,640	43%	155,014	116,175	271,189	43%	16,673	12,496	29,169	43%
1985	27,514	27,734	55,248	50%	131,406	132,459	263,865	50%	39,268	39,583	78,852	50%
1987	92,527	72,642	165,169	44%	56,879	44,656	101,535	44%	4,221	3,314	7,536	44%
1989	95,377	231,490	326,867	71%	84,465	145,604	230,069	63%	2,431	4,101	6,532	63%
1991	9,260	9,621	18,882	51%	6,120	4,803	10,923	44%	11,780	9,087	20,867	44%
1993	223,464	201,303	424,767	47%	11,231	8,536	19,767	43%	3,858	2,904	6,761	43%
1995	13,864	13,547	27,411	49%	4,450	2,852	7,301	39%	2,546	1,587	4,133	38%
1997	3,258	2,103	5,361	39%	3,008	1,206	4,214	29%	2,925	1,135	4,060	28%
1999	4,682	72	4,754	2%	2,271	24	2,295	1%	2,870	30	2,899	1%
2001	72,578	6,673	79,251	8%	22,169	1,362	23,531	6%	10,597	634	11,232	6%
2003	10,838	2,954	13,791	21%	9,735	2,403	12,139	20%	20,753	5,096	25,848	20%
2005	83,644	5,154	88,798	6%	435	22	457	5%	39,297	1,958	41,255	5%
2007	294,377	10,771	305,147	4%	1,228	11	1,239	1%	26,366	196	26,562	1%
2009	635,912	54,538	690,450	8%	3,132	114	3,246	4%	143,588	4,861	148,448	3%
2011	84,327	45,268	129,595	35%	900	349	1,249	28%	24,717	9,386	34,103	28%
2013	293,363	31,054	324,416	10%	12,325	491	12,816	4%	151,247	5,504	156,751	4%
2015	434,092	9,647	443,738	2%	933	4	938	0%	13,412	49	13,461	0%

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