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**Canadian Enhanced Salmonid Production
During 1978-2007 (1977 – 2006 Brood Years)**

by

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Abstract

The Salmonid Enhancement Program (SEP) in British Columbia, Canada was initiated in 1977 to rebuild stocks and increase catch through the expanded use of enhancement technology. The program comprises nearly 300 projects that produce chinook (*Oncorhynchus tshawytscha*), coho (*O. kisutch*), chum (*O. keta*), pink (*O. gorbuscha*), and sockeye salmon (*O. nerka*), as well as small numbers of steelhead salmon (*O. mykiss*) and cutthroat trout (*O. clarki*). Projects include hatcheries, fishways, spawning and rearing channels, habitat improvements, flow control works, lake fertilization, and small classroom incubators, and range in size from spawning channels releasing nearly 100 million juveniles annually, to schools with classroom incubators that release fewer than one thousand. Data from facilities that operate outside the direction of SEP are not included in this report. Steelhead and cutthroat are a provincial government responsibility, but some enhancement takes place at SEP facilities under a cooperative arrangement. Steelhead and cutthroat numbers in this report do not include releases from facilities operated by the Freshwater Fisheries Society of British Columbia.

Introduction

The purpose of this document is to summarise release information from enhancement facilities in British Columbia (BC) and the Yukon Territory. More detailed information is available from the Salmonid Enhancement Planning and Assessment Unit within the Oceans, Habitat & Enhancement Branch of Fisheries and Oceans Canada.

The Salmonid Enhancement Program (SEP) in British Columbia, Canada was initiated in 1977 primarily to rebuild depressed stocks and increase catch through the expanded use of enhancement technology. The program was designed to increase fishing opportunities, involve the public and raise awareness, create jobs and increase economic development in coastal and First Nations communities, and improve understanding of salmonid populations. SEP incorporated three existing spawning channels built in the 1960's and five production hatcheries that began operation in the early 1970's.

SEP was combined with Habitat Management in 1995 and is currently managed by the Oceans, Habitat and Enhancement Branch (OHEB) of Fisheries & Oceans Canada. The enhancement program comprises nearly 300 projects throughout British Columbia that produce chinook (*Oncorhynchus tshawytscha*), coho (*O. kisutch*), chum (*O. keta*), pink (*O. gorbuscha*), and sockeye salmon (*O. nerka*), as well as small numbers of steelhead salmon (*O. mykiss*) and cutthroat trout (*O. clarki*).

Projects include hatcheries, fishways, spawning and rearing channels, and small classroom incubators, ranging in size from spawning channels producing nearly 100 million juvenile salmon annually to school classroom incubators releasing fewer than one hundred juveniles. Projects are operated by OHEB staff or contracted to community and native groups, as well as by volunteers with some OHEB support. Up to 10,000 volunteers participate annually in habitat restoration and improvement projects. OHEB works with First Nations, industry, community groups and other government agencies to design and implement habitat restoration projects.

A public involvement and education program offers technical support and funding to volunteers who operate community salmonid enhancement and stewardship projects, training and supporting the public to actively monitor, protect, and improve fish habitats. OHEB developed educational packages to teach children about salmon and the need to protect habitat and watersheds. OHEB staff also provide technical advice to enhancement activities, including hatcheries, which operate outside OHEB.

Methods

Depending on the species and enhancement approach, fish are released at various stages. Chum and pink salmon are released either immediately after emergence from channels or incubation boxes (unfed fry) or after one month of feeding (fed fry). Coho are released as fry, either at emergence or after 3 to 5 months of rearing, or as smolts after one year of rearing. Most sockeye emigrate volitionally from channels soon after emergence, although a small number are hatchery incubated and reared. Sockeye are also enhanced through lake fertilization programs, and most migrate to sea after one year of lake rearing. Coastal stocks of chinook are released after 3 - 4 months of rearing, while interior stocks are frequently reared for one year. As the latter constitute a very small component of the total numbers of chinook released, they are not tabulated separately in this report.

Releases from hatcheries are usually estimated by subtracting known egg and fry mortalities from egg numbers while releases from manned channels are estimated by sampling outmigrants.

Annual egg and juvenile release targets for hatcheries are set pre-season for each stock, in consultation with project managers, stock assessment biologists and harvest management biologists. Potential adult production (based on previous average survival rates), species interactions, effects on natural stocks, harvest concerns, habitat capacity and project capacity are considered when developing targets.

Enhanced contributions and survivals of chinook, coho, and chum salmon are estimated by marking a portion of the fish released and subsequently recovering these marked fish in fisheries and the escapement. Pinks are not currently marked. Marking occurs prior to release, and recovery takes place through sampling programs in the sport, commercial and aboriginal fisheries and through recovery programs on the spawning grounds and at enhancement sites. Marks vary by species, with coded wire tags used for chinook, coho and some chum stocks, and finclips used for other chum and sockeye stocks. Beginning in 1996, most enhanced coho from southern B.C. have been marked with a fin clip to enable the prosecution of selective hatchery-mark fisheries.

It is not possible to assess each enhancement project and release strategy. Consequently, certain stocks are used as indicators, their production is marked annually and rigorous escapement sampling and estimation programs are normally carried out. Survival and exploitation estimates are used for time series analyses of both wild and enhanced populations.

There are relatively few projects that enhance sockeye and pink salmon. Sockeye production is estimated using run reconstruction or historical survivals. Experimental groups of reared sockeye, mainly stock of conservation concern, may be marked with finclips, with recovery on the spawning grounds or at the project. No marking of pinks has occurred since brood year 1992.

Some species and stocks are given a thermal otolith mark to estimate enhanced contributions to terminal areas. Thermal marking is coordinated with the Stock Assessment Division. Additionally, a few stocks, mainly sockeye, have been marked with strontium chloride, a naturally occurring salt, or with calcein, a fluorescing dye.

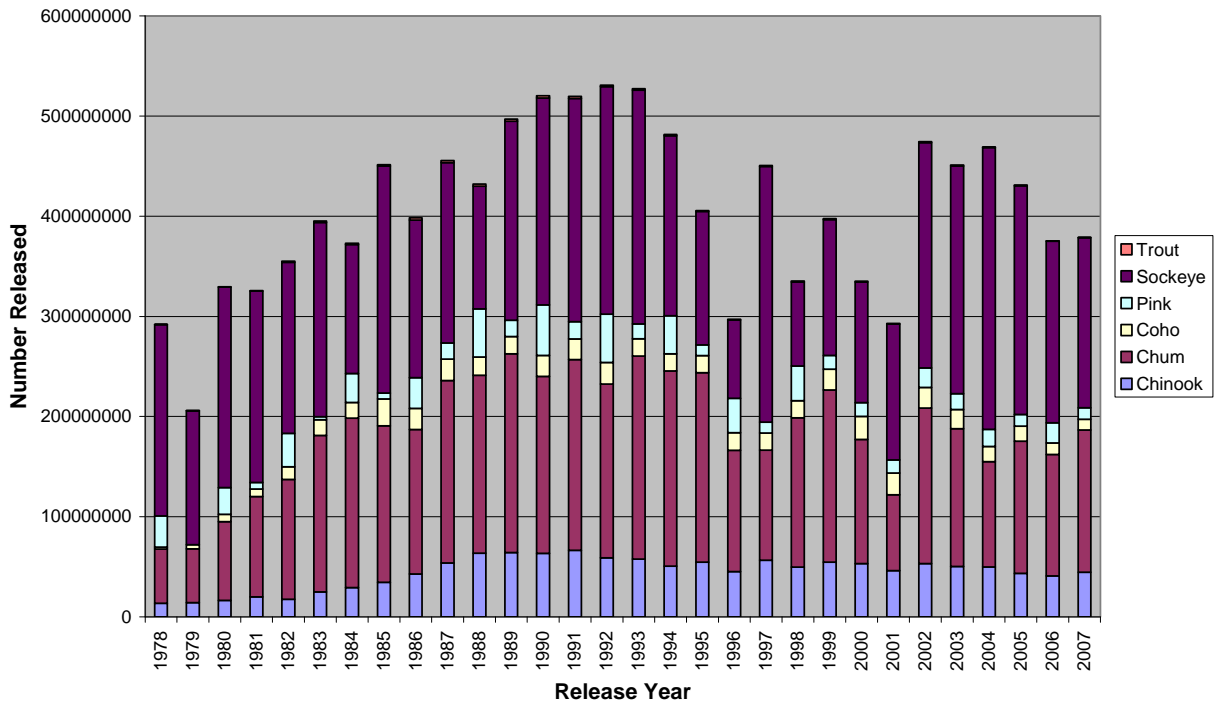
Results

Release numbers are provided by brood (Table 1) and release (Table 2) year. Releases in 2007 are broken down by area (Table 3). Data for the final year presented (2006 brood and 2007 release year) are preliminary and will be updated in future reports. Similarly, this report updates release numbers provided in earlier reports. Releases have been added for 1985-1996 release years from a small program that was

not included in the past. Locations of larger BC facilities reporting releases in the tables are shown in Figures 1a, 1b and 1c.

The tables include releases from hatcheries and manned spawning channels operated by OHEB staff, contracted to community and native groups or operated by volunteer groups under the direction of OHEB staff. Production from unmanned channels, overwintering ponds, lake enrichment programs and other habitat restoration projects are not included in the tables. Steelhead and cutthroat numbers do not include releases from facilities operated by the Freshwater Fisheries Society of B.C. Additional information about steelhead and cutthroat releases can be found in the Stocking Reports on the Freshwater Fisheries Society of BC web site at <http://www.gofishbc.com>. Releases are reported for facilities funded through the Aboriginal Fisheries Strategy only for projects that receive significant technical support from OHEB.

**Releases from Enhancement Facilities in British Columbia,
Yukon and Transboundary Area, Canada**



Total releases approximately doubled between the 1977 and 1988 brood years, with the largest numerical increase for chum fry. Poor marine survival in the mid to late 1990's for some southern B.C. chum stocks led to decreased escapement, resulting in lower production for several years. In 1999, egg targets at Fraser River facilities were reduced in response to lower harvest rates on Fraser River chum. Maximum production of chinook and coho smolts releases was reached in the early to mid 1980s. Since 1998 there has been an increased focus toward rebuilding severely depressed stocks, including interior Fraser River coho and Cultus Lake sockeye. Pink releases fluctuate annually because of the natural cycles (odd year only) in the Fraser River. In 1999, a large pink spawning channel (20 million releases) on the Fraser was complexed for all species and is no longer managed as a spawning channel. Production from Fraser River sockeye channels fluctuates because of natural cycles. Since 1994, disease mortality in some years has affected spawning success for Skeena River sockeye channel production. In 2004, (2005 or 2006 release year depending on species), to meet budget constraints, production was reduced where stocks were strong

and returns to hatchery locations exceeded spawning requirements. Chinook and coho targets were the most affected. Production was maintained for all stocks enhanced for rebuilding objectives. The Doug Little Hatchery at Penny, producing Dome Creek chinook, was closed in 2006 due to structural problems and is proposed for relocation to another upper Fraser River site.

OHEB continues to implement habitat restoration and stewardship projects throughout B.C. Cooperative programs with other governmental and non-governmental agencies include constructing side-channels, increasing water flows, stabilizing stream banks, enriching nutrient poor lakes and rivers, and rebuilding estuary marshes.

Summary

Data are presented for releases by brood and release year, species and release stage for facilities under the direction of the Oceans, Habitat & Enhancement Branch of Fisheries & Oceans Canada. Since 1998, Fisheries & Oceans Canada has implemented more conservation based management of salmon fisheries. Enhancement activities are focused towards supporting targeted fishing opportunities on enhanced stocks and rebuilding severely depressed stocks.

Figure 1a Locations of hatcheries and manned spawning channels operated by OHEB staff or contracted to community and native groups within British Columbia's Fraser River watershed and lower mainland

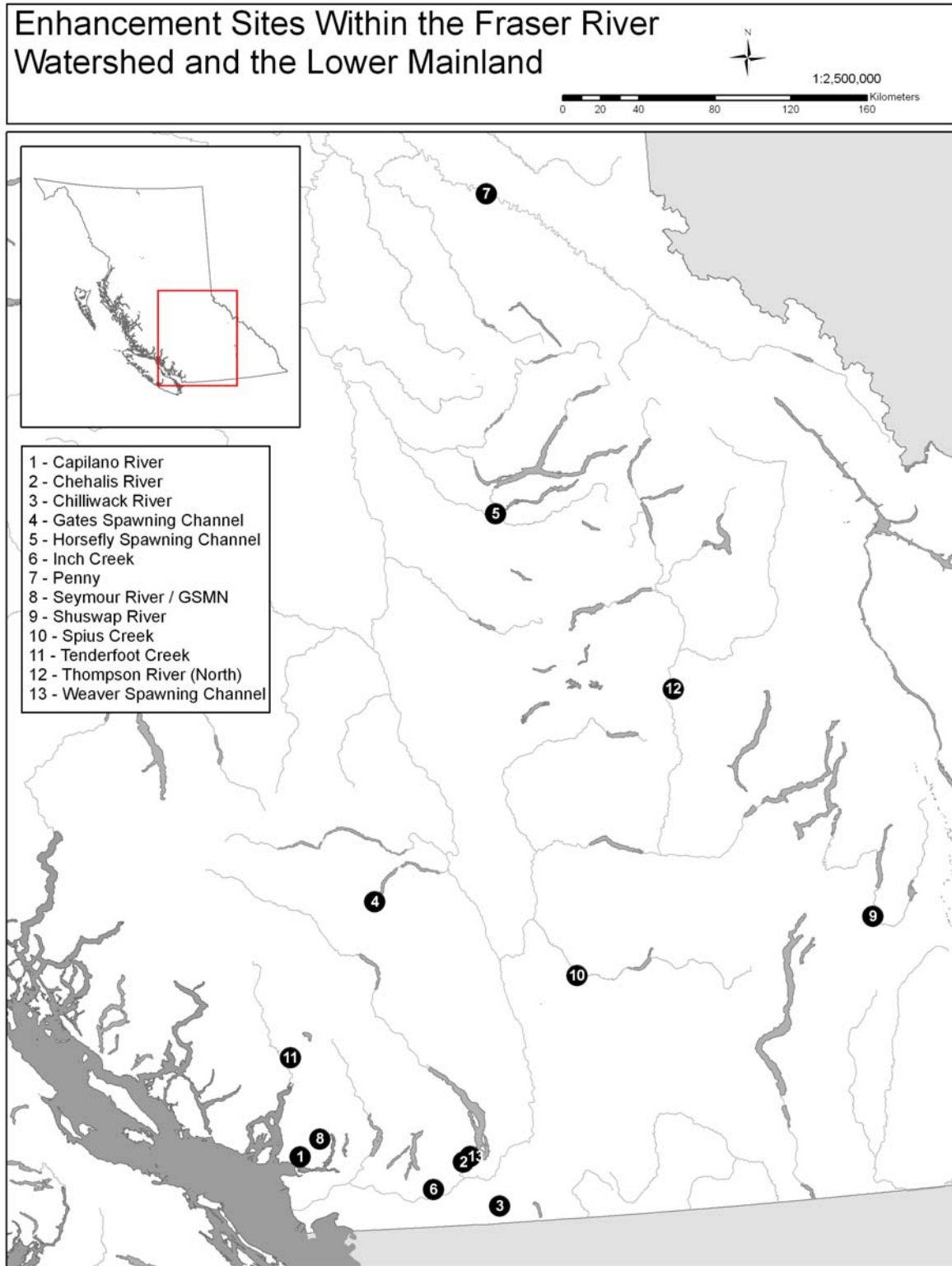


Figure 1b Locations of hatcheries and manned spawning channels operated by OHEB staff or contracted to community and native groups within British Columbia's North and Central Coast Regions.

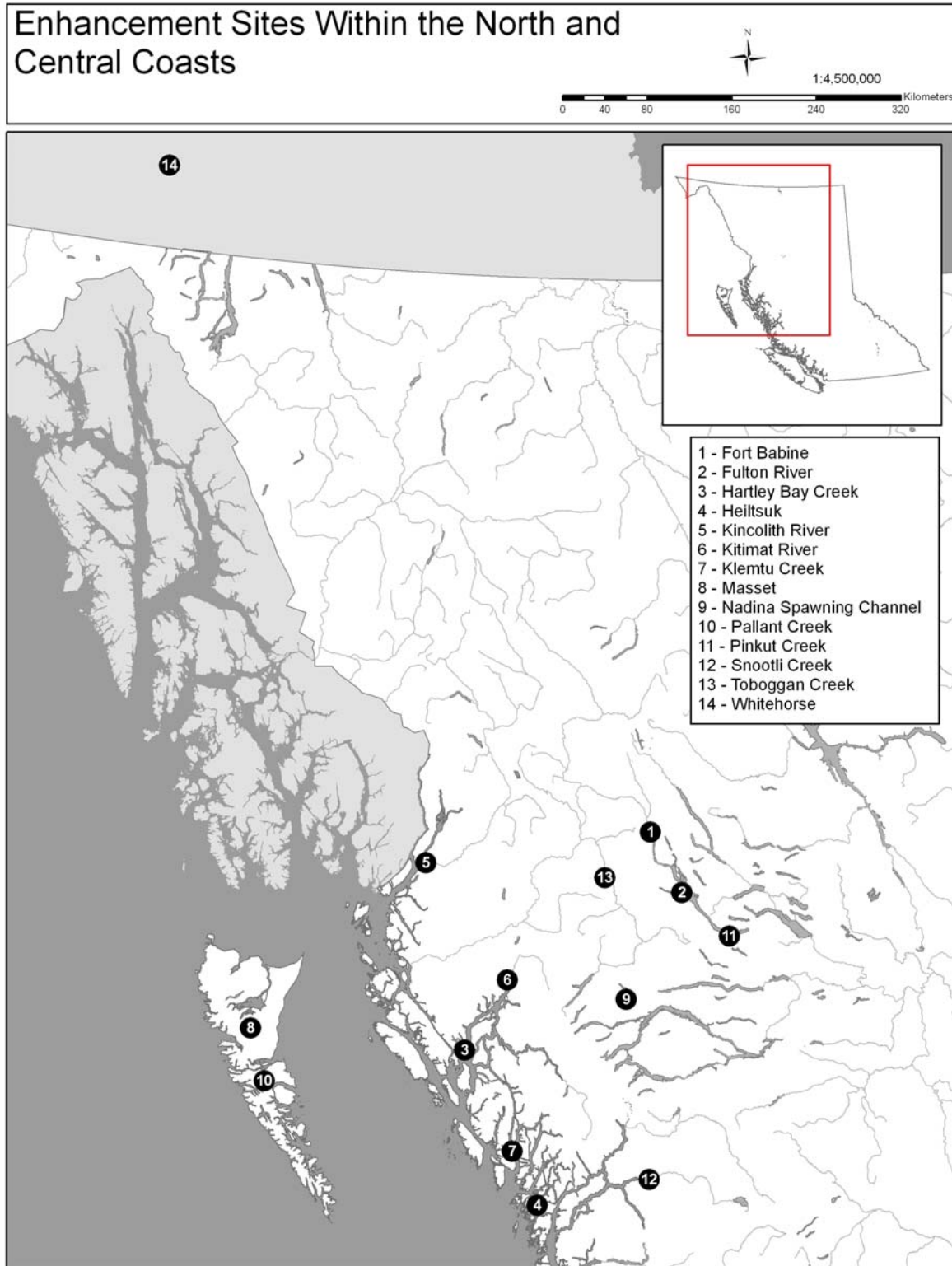


Figure 1c Locations of hatcheries and manned spawning channels operated by OHEB staff or contracted to community and native groups within British Columbia's Strait of Georgia and Vancouver Island

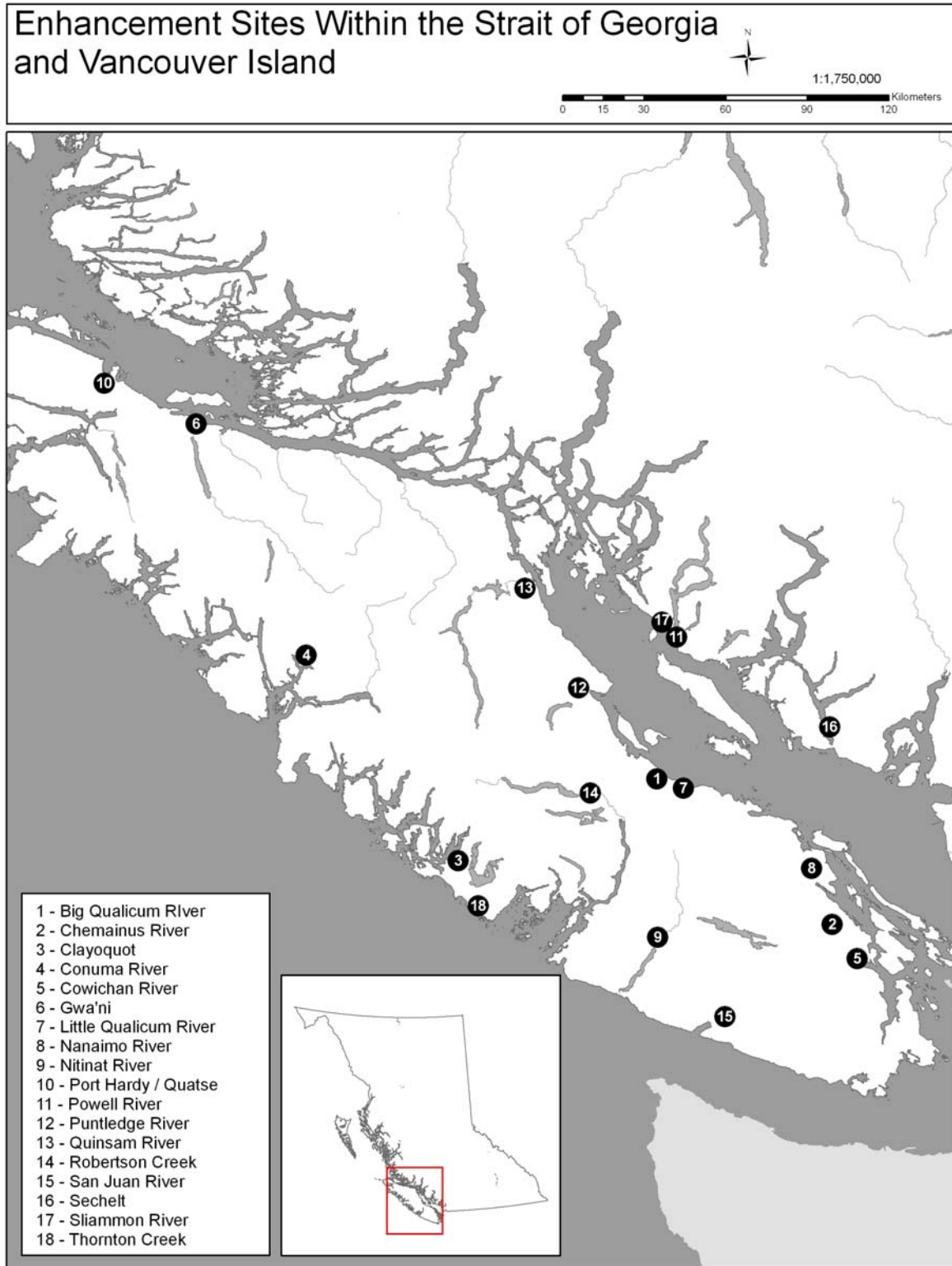


Table 1. Juvenile salmon releases by brood year from OHEB hatcheries and manned channels in British Columbia, Yukon, and Transboundary Area, Canada

Brood Year	Chinook	Chum		Coho		Pink		Sockeye	Trout	
		Unfed	Fed	Fry	Smolt	Unfed	Fed		Cutthroat	Steelhead
1977	13,620,370	52,127,027	1,904,625	2,073,819	2,984,462	31,029,220		191,179,000		127,810
1978	14,253,404	48,218,296	5,535,566	1,012,721	3,741,951	750		133,739,000		268,918
1979	16,379,080	69,550,228	9,191,947	3,691,819	4,963,264	26,145,904	358,639	200,179,521	682	310,292
1980	19,850,845	70,604,678	29,684,300	2,449,038	5,229,572	4,705,834	1,859,631	191,071,400	3,012	396,584
1981	17,493,149	50,709,042	68,980,710	7,311,022	4,889,684	33,113,088	492,034	170,814,370	9,732	711,136
1982	24,854,529	86,930,258	69,365,130	10,773,108	6,898,222	2,510,301	423,038	194,054,919	43,077	956,643
1983	29,374,066	83,266,067	85,579,589	8,930,958	13,585,563	27,341,916	1,521,896	128,964,333	33,970	1,400,810
1984	34,864,768	52,525,108	103,779,630	13,150,827	12,000,760	3,783,368	2,296,285	226,572,635	72,347	1,311,591
1985	42,736,623	41,608,091	102,464,677	9,286,657	9,698,356	25,432,597	5,057,021	157,434,930	109,045	1,502,291
1986	53,815,001	96,273,382	85,842,800	11,752,760	10,108,174	11,585,712	4,509,098	180,106,075	157,749	2,073,374
1987	63,693,726	101,661,170	75,979,591	8,177,303	9,555,691	43,221,480	4,807,689	122,471,589	179,737	1,896,518
1988	64,435,641	110,287,223	88,028,664	7,836,404	11,182,526	13,504,123	2,827,349	198,689,081	194,543	1,940,636
1989	63,504,499	84,537,150	92,214,006	9,878,700	11,729,968	47,373,147	2,884,163	206,752,792	164,027	1,840,159
1990	66,431,805	95,715,249	94,759,699	8,834,612	12,118,500	16,102,839	1,023,076	223,080,058	181,781	1,841,700
1991	59,554,198	76,557,826	96,839,355	9,350,809	10,708,412	46,709,818	1,584,525	227,135,058	178,076	1,642,679
1992	57,728,670	113,382,987	89,286,432	6,468,538	10,383,332	12,982,461	1,781,339	233,649,779	159,793	1,200,172
1993	50,717,102	101,495,532	93,399,435	6,571,925	10,766,275	36,575,827	1,576,168	179,704,118	172,851	1,061,360
1994	53,858,696	85,189,766	103,998,196	6,379,202	10,652,207	8,576,269	1,981,042	133,196,977	120,128	1,008,803
1995	45,198,459	33,223,512	87,665,283	6,980,359	11,298,960	32,317,111	2,001,615	78,186,811	128,428	960,635
1996	56,857,740	16,662,042	93,102,003	5,798,723	11,795,961	9,456,957	1,472,567	255,261,453	138,214	711,072
1997	49,914,928	45,104,033	104,106,311	5,212,022	11,594,104	33,090,039	1,640,496	83,807,632	85,676	995,164
1998	54,180,664	80,420,855	91,556,525	9,104,197	14,439,559	13,643,600	150,482	135,638,928	127,234	647,365
1999	53,266,715	45,515,245	78,593,285	8,367,907	12,780,771	10,588,053	3,198,637	120,547,649	105,283	670,415
2000	45,971,848	16,468,059	59,351,149	8,734,094	12,752,744	12,193,240	999,207	135,650,027	76,387	686,101
2001	52,836,982	73,981,946	81,394,064	7,866,302	13,538,679	16,885,480	2,550,411	225,112,415	52,844	781,610
2002	50,320,352	55,510,125	82,166,643	5,574,418	10,439,795	14,589,187	1,161,483	227,528,947	79,746	704,550
2003	49,736,616	50,478,858	54,680,148	4,666,462	10,649,077	15,624,437	1,423,758	281,420,261	74,097	643,327
2004	43,504,042	60,027,600	71,759,170	4,598,708	8,474,461	10,521,438	998,000	228,276,027	40,205	735,107
2005	40,939,961	35,595,427	85,585,443	2,933,491	7,997,852	17,096,080	3,034,252	181,141,578	32,253	500,753
2006	43,741,181	63,674,932	78,337,246	2,852,928		10,130,010	1,419,281	169,670,060	42,098	459,267

Table 2. Juvenile salmon releases by release year from OHEB hatcheries and manned channels in British Columbia, Yukon, and Transboundary Area, Canada

Release Year	Chinook	Chum		Coho		Pink		Sockeye	Trout	
		Unfed	Fed	Fry	Smolt	Unfed	Fed		Cutthroat	Steelhead
1978	13,582,355	52,127,027	1,904,625	2,073,819		31,029,220		191,179,000		166,941
1979	14,266,797	48,218,296	5,535,566	1,012,721	2,984,462	750		133,739,000	682	290,453
1980	16,370,618	69,550,228	9,191,947	3,691,819	3,741,951	26,145,904	358,639	200,179,521	2,000	355,750
1981	19,818,676	70,604,678	29,684,300	2,449,038	4,963,264	4,705,834	1,859,631	191,071,400	5,700	500,275
1982	17,532,160	50,709,042	68,980,710	7,293,522	5,229,572	33,113,088	492,034	170,814,370	13,608	976,734
1983	24,875,258	86,930,258	69,365,130	10,790,608	4,889,684	2,510,301	423,038	194,054,919	37,913	1,191,999
1984	29,377,307	83,266,067	85,579,589	8,920,958	6,881,907	27,341,916	1,521,896	128,964,333	24,658	1,285,719
1985	34,453,016	52,525,108	103,779,630	13,104,103	13,576,282	3,783,368	2,296,285	226,572,635	92,728	1,330,355
1986	42,839,609	41,608,091	102,464,677	9,291,915	12,021,784	25,432,597	5,057,021	157,434,930	110,507	2,201,706
1987	53,704,259	96,273,382	85,842,800	11,804,226	9,702,443	11,585,712	4,509,098	180,077,635	162,435	1,889,935
1988	63,564,914	101,661,170	75,979,591	8,177,303	10,108,659	43,221,480	4,807,689	122,480,753	191,794	1,810,897
1989	64,153,098	110,287,223	88,028,664	7,836,404	9,555,691	13,504,123	2,827,349	198,639,174	181,020	1,791,215
1990	63,296,682	84,537,150	92,214,006	9,878,700	11,182,526	47,373,147	2,884,163	206,749,382	158,512	1,950,953
1991	66,406,884	95,715,249	94,759,699	8,834,292	11,729,968	16,102,839	1,023,076	223,152,651	184,025	1,626,254
1992	59,073,447	76,557,826	96,839,355	9,330,179	12,118,500	46,709,818	1,584,525	227,135,058	180,389	1,307,943
1993	57,764,444	113,382,987	89,286,432	6,489,488	10,708,412	12,982,461	1,781,339	233,649,779	162,443	1,160,891
1994	50,656,952	101,495,532	93,399,435	6,554,925	10,383,332	36,575,827	1,576,168	179,704,118	148,498	1,068,134
1995	54,526,006	85,189,766	103,998,196	6,396,202	10,766,275	8,576,269	1,981,042	133,196,977	116,773	940,106
1996	45,290,641	33,223,512	87,665,283	6,974,359	10,652,207	32,317,111	2,001,615	78,186,811	136,085	705,929
1997	56,617,049	16,662,042	93,102,003	5,787,889	11,298,960	9,456,957	1,472,567	255,261,453	136,258	886,307
1998	49,609,162	45,104,033	104,106,311	5,184,831	11,795,961	33,138,850	1,640,496	83,807,632	84,487	779,604
1999	54,627,132	80,420,855	91,556,525	9,139,665	11,594,104	13,594,789	150,482	135,637,678	126,087	687,682
2000	53,070,700	45,515,245	78,593,285	8,376,464	14,439,559	10,588,053	3,198,637	120,566,525	109,271	650,463
2001	46,093,387	16,468,059	59,351,149	8,734,094	12,780,771	12,193,240	999,207	135,628,510	74,831	657,980
2002	53,035,886	73,981,946	81,394,064	7,866,302	12,752,744	16,885,480	2,550,411	225,113,140	48,488	723,350
2003	50,196,925	55,510,125	82,166,643	5,572,373	13,538,679	14,589,187	1,161,483	227,522,171	81,654	725,540
2004	49,781,434	50,478,858	54,680,148	4,662,462	10,439,795	15,624,437	1,423,758	281,353,125	77,460	687,937
2005	43,534,540	60,027,600	71,759,170	4,586,753	10,649,077	10,521,438	998,000	228,273,931	39,476	728,578
2006	40,948,457	35,595,427	85,585,443	3,051,546	8,519,183	17,096,080	3,034,252	181,140,166	35,135	528,903
2007	44,567,865	63,674,932	78,337,246	2,752,873	7,953,130	10,130,010	1,419,281	169,750,646	40,098	372,166

Table 3. Juvenile salmon releases by area in 2007 from OHEB hatcheries and manned channels in British Columbia, Yukon, and Transboundary Area, Canada

Area	Stat Area	Chinook	Chum	Coho	Pink	Sockeye	Trout
Nass R	03	29,205		140			
	Total	29,205		140			
Skeena R	04A	279,973		118,088		112,696,257	
	Total	279,973		118,088		112,696,257	
North Coast	04	175	7,435	28,322			
	06	1,647,816	4,622,504	443,573			52,810
	Total	1,647,991	4,629,939	471,895			52,810
Queen Charlotte Islands	01	243,190		25,888			
	02E	3,473	14,294,310	491,483	4,116		
	Total	246,663	14,294,310	517,371	4,116		
Central Coast	07		2,383,615	63,329		133,875	
	08	2,472,701	6,772,081	53,949		128,811	
	Total	2,472,701	9,155,696	117,278		262,686	
West Coast Vancouver Island	22	3,693,049	28,909,371	285,455			
	23	7,039,551	109,617	1,418,774			106,605
	24	566,388		64,252			
	25	2,462,852	2,909,211				
	27	485,101		111,898			
	Total	14,246,941	31,928,199	1,880,379			106,605
Johnstone Strait	12		4,047,337	228,812	2,471,889	581,829	31,246
	Total		4,047,337	228,812	2,471,889	581,829	31,246
Strait of Georgia	13	4,461,452	48,533	729,509	6,343,946		10,020
	14	10,307,520	59,307,311	1,550,888	2,309,659		2,333
	15	801,521	2,199,667	322,466			
	16	286,754	76,600	150,341		87,016	
	17	806,282	531,702	119,937	419,681		
	18	939,971	375,785	1,457			
	19	197,100	108,453	115,458			
	20	1,455,815	1,607	60,985			
	28	1,995,160	807,158	1,265,368			44,571
	Total	21,251,575	63,456,816	4,316,409	9,073,286	87,016	56,924
Lower Fraser	29A			770			
	29B	90,000	50,000	44,000			
	29C	393,836	290,747	213,437			
	29D	786,489	12,113,427	1,395,903		49,193,558	69,420
	29E	1,597,668	2,045,707	1,114,669			95,259
	Total	2,867,993	14,499,881	2,768,779		49,193,558	164,679
Upper Fraser	29F	571,823		230,672			
	29G	900					
	29I	900				5,450,000	
	29J			56,180			
	29K	951,200				1,479,300	
	Total	1,524,823		286,852		6,929,300	
Total All Areas		44,567,865	142,012,178	10,706,003	11,549,291	169,750,646	412,264