

NPAFC

Doc. 1039

Rev. _____

Rev. Date: _____

**Canadian Enhanced Salmonid Production
During 1978-2006 (1977 – 2005 Brood Years)**

by

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Submitted to the

North Pacific Anadromous Fish Commission

by

CANADA

August 2007

THIS PAPER MAY BE CITED IN THE FOLLOWING MANNER:

Cook, R., and J.R. Irvine. 2007. Canadian enhanced salmonid production during 1978-2006 (1977-2005 brood years). NPAFC Doc. 1039. 10 pp. (Available at <http://www.npafc.org>).

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 Enhancement Support 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 thousand 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 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.

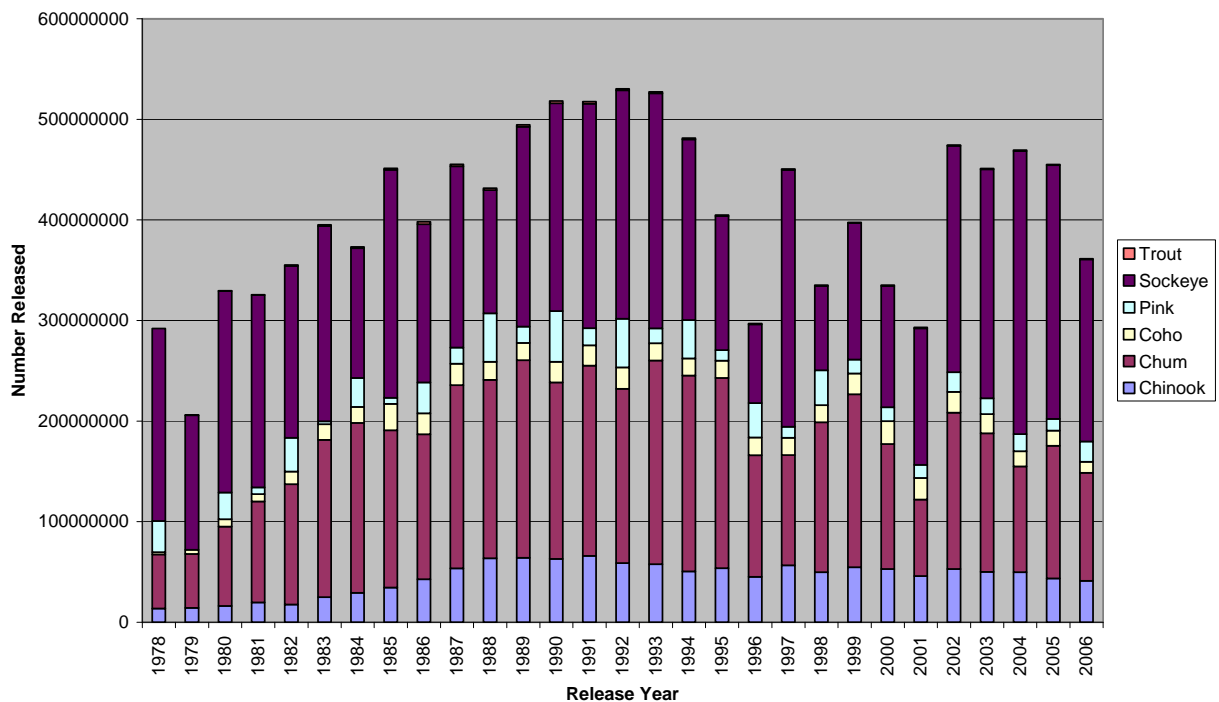
Some species and stocks are given a thermal otolith mark to estimate enhanced contributions to terminal areas. Thermal marking is coordinated with the Stock Assessment Division. Additionally, a few stocks, mainly sockeye, have been marked with strontium chloride, a naturally occurring salt, or with calcein,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

Results

Release numbers are provided by brood (Table 1) and release (Table 2) year. Releases in 2006 are broken down by area (Table 3). Data for the final year presented (2005 brood and 2006 release year) are preliminary and will be updated in future reports. Similarly, this report updates release numbers provided in earlier reports. 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 Fisheries Inventory Database on the B.C. Ministry of Sustainable Resource Management web site at <http://www.bcfisheries.gov.bc.ca/>. 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

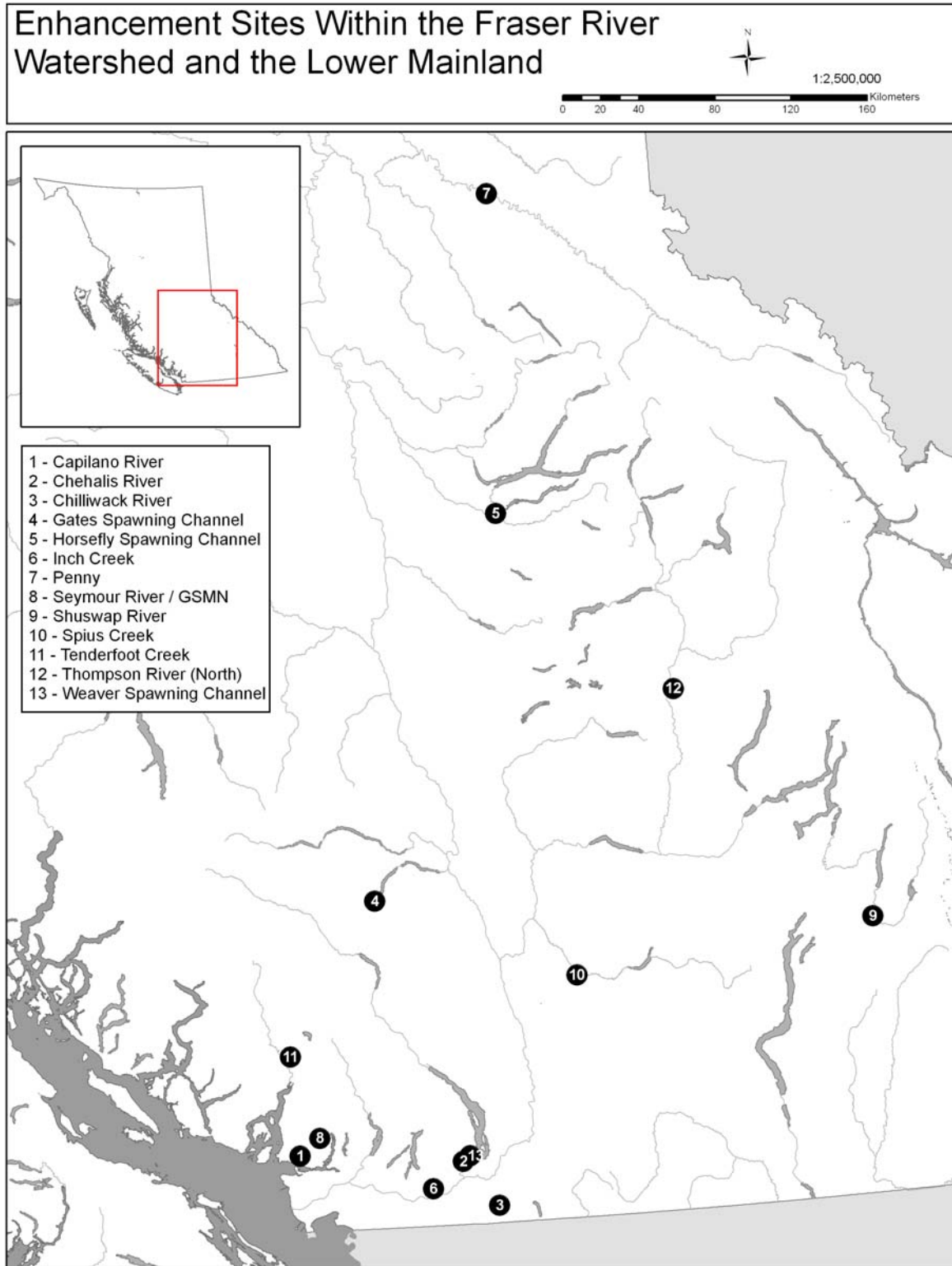


Figure 1b Locations of hatcheries and manned spawning channels operated by OHEB staff or contracted to community and native groups within British Columbia's North and Central Coast Regions.

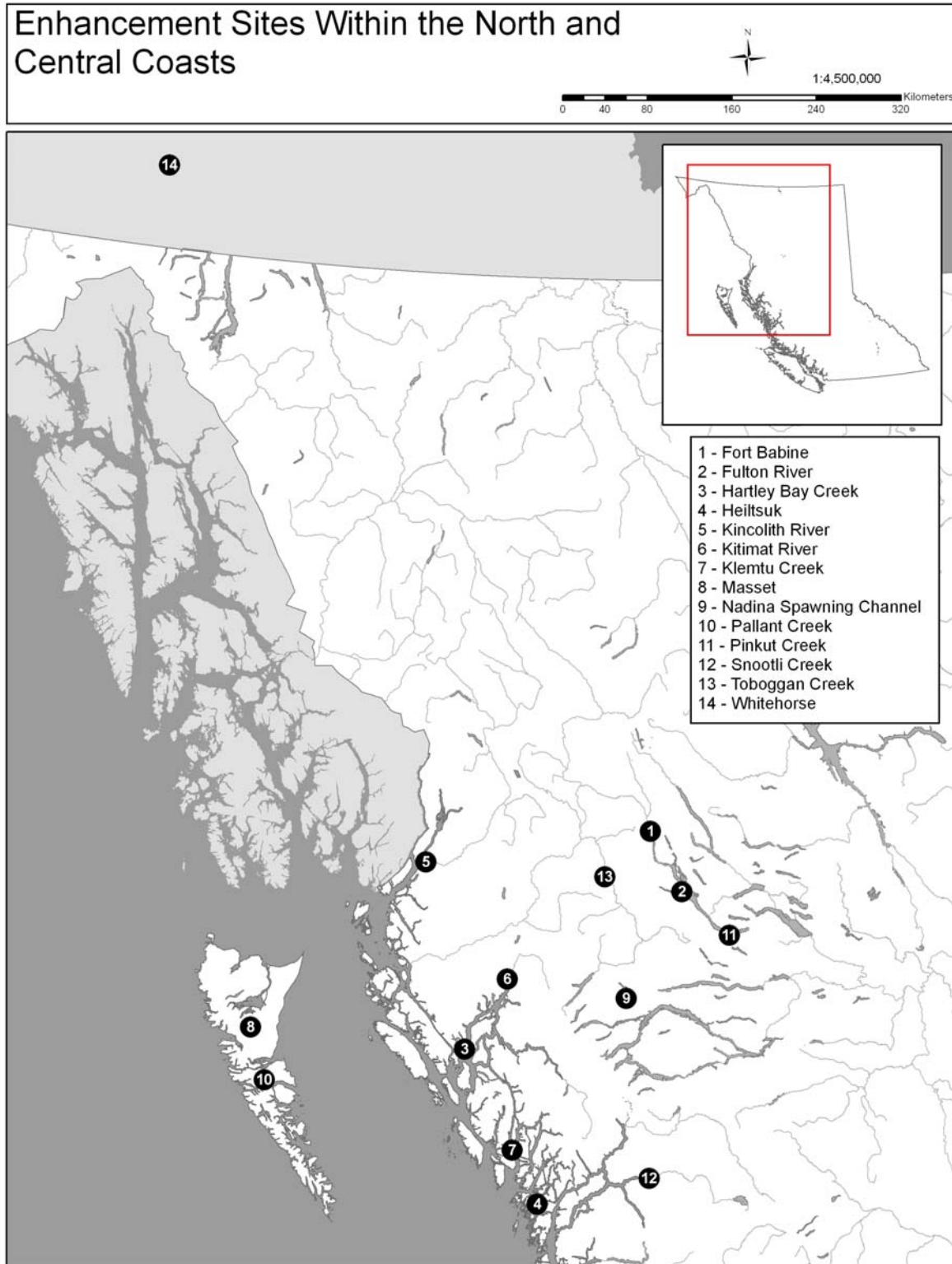


Figure 1c Locations of hatcheries and manned spawning channels operated by OHEB staff or contracted to community and native groups within British Columbia's Strait of Georgia and Vancouver Island

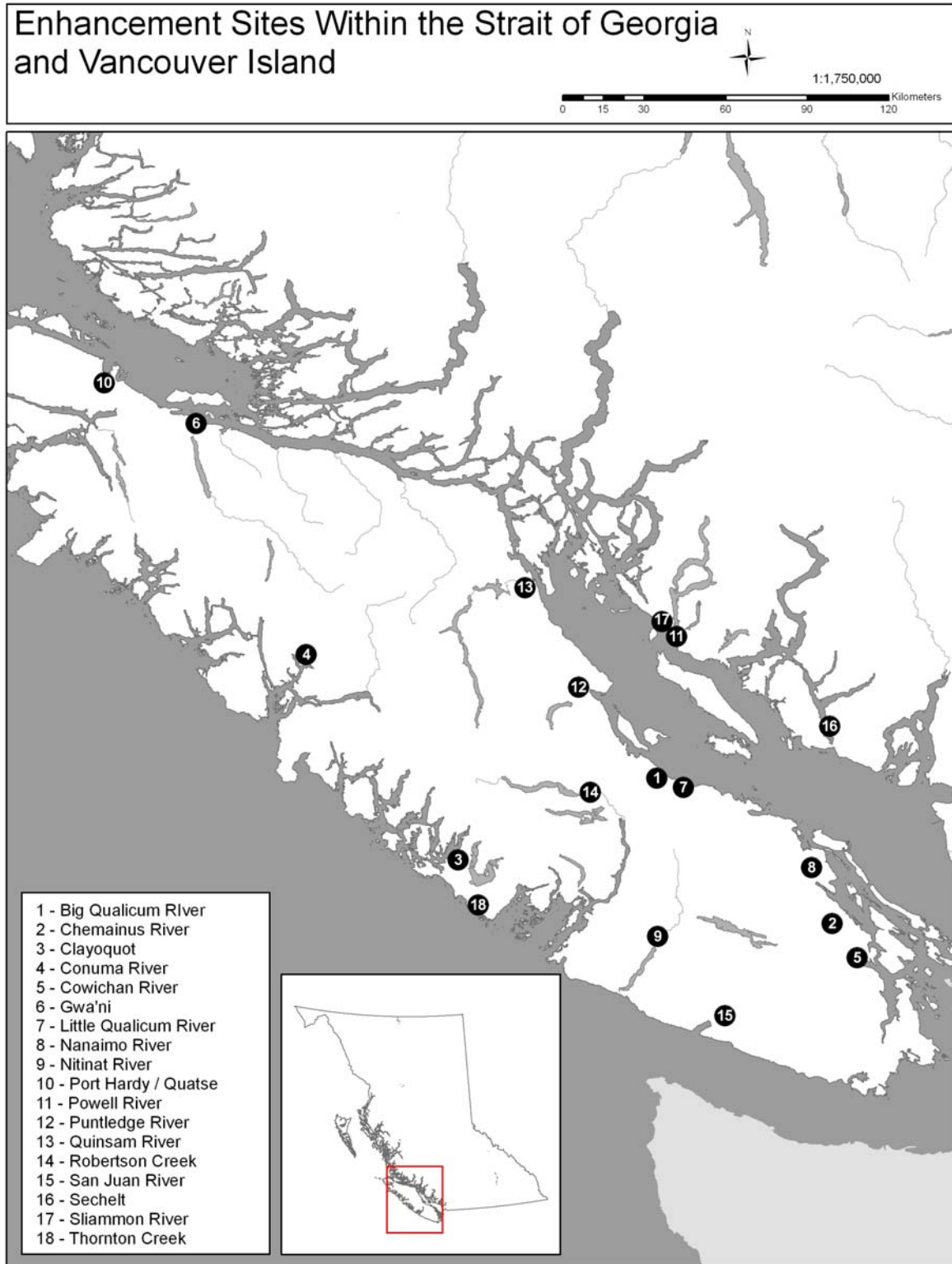


Table 1. Juvenile salmon releases by brood year from OHEB hatcheries and manned channels in British Columbia, Yukon, and Transboundary Area, Canada

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	12,887,280	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	8,868,652	9,698,356	25,432,597	5,057,021	157,434,930	109,045	1,501,462
1986	53,815,001	96,273,382	85,842,800	11,505,565	10,087,259	11,585,712	4,509,098	180,106,075	157,749	2,073,374
1987	63,631,981	101,451,170	75,979,591	8,066,239	9,528,691	43,221,480	4,807,689	122,471,589	179,737	1,896,518
1988	64,254,578	108,566,723	87,928,664	7,668,159	11,162,586	13,504,123	2,827,349	198,689,081	194,543	1,940,636
1989	63,254,499	82,968,150	92,214,006	9,617,976	11,699,468	47,373,147	2,884,163	206,752,792	164,027	1,840,159
1990	66,114,433	94,291,267	94,759,699	8,505,864	12,092,119	16,102,839	1,023,076	223,080,058	181,781	1,841,700
1991	59,326,978	76,457,221	96,839,355	9,192,045	10,689,827	46,709,818	1,584,525	227,135,058	178,076	1,642,679
1992	57,663,640	113,382,987	89,286,432	6,367,148	10,365,043	12,982,461	1,781,339	233,649,779	159,793	1,200,172
1993	50,534,844	101,495,532	93,399,435	6,457,407	10,749,888	36,575,827	1,576,168	179,704,118	172,851	1,061,360
1994	53,131,692	85,189,766	103,998,196	6,250,436	10,619,207	8,576,269	1,981,042	133,196,977	120,128	1,008,803
1995	45,082,659	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	56,840,800	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	45,671,848	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	8,679,913	10,521,438	998,000	252,176,027	40,205	711,016
2005	40,770,536	35,562,783	71,527,481	2,458,175	n/a	17,096,080	3,034,252	181,060,992	32,253	495,252

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	12,840,556	13,576,282	3,783,368	2,296,285	226,572,635	92,728	1,329,526
1986	42,839,609	41,608,091	102,464,677	8,873,910	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	11,557,031	9,702,443	11,585,712	4,509,098	180,077,635	162,435	1,889,935
1988	63,503,169	101,411,170	75,979,591	8,066,239	10,087,744	43,221,480	4,807,689	122,480,753	191,794	1,810,897
1989	63,972,035	108,566,723	87,928,664	7,668,159	9,528,691	13,504,123	2,827,349	198,639,174	181,020	1,791,215
1990	63,046,682	83,008,150	92,214,006	9,617,976	11,162,586	47,373,147	2,884,163	206,749,382	158,512	1,950,953
1991	66,089,512	94,291,267	94,759,699	8,505,544	11,699,468	16,102,839	1,023,076	223,152,651	184,025	1,626,254
1992	58,846,227	76,457,221	96,839,355	9,171,415	12,092,119	46,709,818	1,584,525	227,135,058	180,389	1,307,943
1993	57,699,414	113,382,987	89,286,432	6,388,098	10,689,827	12,982,461	1,781,339	233,649,779	162,443	1,160,891
1994	50,474,694	101,495,532	93,399,435	6,440,407	10,365,043	36,575,827	1,576,168	179,704,118	148,498	1,068,134
1995	53,799,002	85,189,766	103,998,196	6,267,436	10,749,888	8,576,269	1,981,042	133,196,977	116,773	940,106
1996	45,174,841	33,223,512	87,665,283	6,974,359	10,619,207	32,317,111	2,001,615	78,186,811	136,085	705,929
1997	56,600,109	16,662,042	93,096,966	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	104,111,348	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	82,141,643	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	54,705,148	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	252,173,931	39,476	704,487
2006	41,305,716	35,562,783	71,527,481	2,476,175	8,724,635	17,096,080	3,034,252	181,140,166	33,135	435,955

Table 3. Juvenile salmon releases by area in 2006 from OHEB hatcheries and manned channels in British Columbia, Yukon, and Transboundary Area, Canada

Area	Stat Area	Chinook	Chum	Coho	Pink	Sockeye	Trout
Yukon & Transboundary	120	233,694	340				
	Total	233,694	340				
Nass R	03		15,581	150			
	Total		15,581	150			
Skeena R	04A	307,897		93,766		128,053,025	
	Total	307,897		93,766		128,053,025	
North Coast	04		278	17,157			
	06	1,634,795	4,809,420	680,161			74,880
	Total	1,634,795	4,809,698	697,318			74,880
Central Coast	07		2,233,779	112,779		87,505	
	08	2,011,568	7,327,717	12,868		717,928	
	Total	2,011,568	9,561,496	125,647		805,433	
West Coast Vancouver Is	22	3,071,115	39,463,947	357,122			1,199
	23	6,652,899	752,227	713,351			90,420
	24	548,419		111,290			
	25	2,120,384	2,349,960	55,924			
	27	36,370	22,840	110,730			
	Total	12,429,187	42,588,974	1,348,417			91,619
Johnstone Strait	11	16,843	4,468	74,722	77,241		
	12	105,669	5,920,299	245,850	2,187,084	1,247,959	38,696
	Total	122,512	5,924,767	320,572	2,264,325	1,247,959	38,696
Str of Georgia	13	4,376,370	305,517	969,989	6,379,616		9,100
	14	9,138,112	32,819,726	2,057,287	6,820,949		12,076
	15	1,198,053	1,627,509	261,625			
	16	285,386	425,362	273,088	186,155	94,510	
	17	625,829	196,348	167,778	594,822		
	18	1,822,307	2,546	1,842			
	19	375,600	70,720	110,164			
	20	785,878	1,607	150,866			
	28	1,346,133	787,191	1,100,429	1,003,416		64,894
	Total	19,953,668	36,236,526	5,093,068	14,984,958	94,510	86,070
Lower Fraser	29A			760			
	29B	117,000	50,000	278,964	110,000		
	29C	344,958	384,236	394,250	693,472		
	29D	1,240,160	6,090,511	1,333,607	2,077,577	36,450,239	68,702
	29E	1,573,151	1,428,135	1,133,389			109,123
	Total	3,275,269	7,952,882	3,140,970	2,881,049	36,450,239	177,825
Upper Fraser	29F	394,112		276,107		5,785,000	
	29G	800					
	29I	110,917				7,320,000	
	29J			52,795			
	29K	831,297		52,000		1,384,000	
	Total	1,337,126		380,902		14,489,000	
Total All Areas		41,305,716	107,090,264	11,200,810	20,130,332	181,140,166	469,090