

**NPAFC**

**Doc. No. 496**

**Rev. No.**

**Enhanced Salmon Production in British Columbia, Canada  
1977 - 1999**

by

Program Coordination and Assessment Division

Department of Fisheries and Oceans  
Habitat and Enhancement Branch  
555 W. Hastings Street  
Vancouver, B.C. V6B 5G3  
CANADA

submitted to the

**NORTH PACIFIC ANADROMOUS FISH COMMISSION**

by

CANADA

September 2000

**This paper may be cited in the following manner:**

Program Coordination and Assessment Division. Canadian enhanced salmon production, 1977-1999. (NPAFC Doc. No 496).9 p. Dept. of Fisheries and Oceans, Habitat and Enhancement Branch, Vancouver, B.C. V6B 5G3.

## **ABSTRACT**

Program Coordination and Assessment Division. An assessment of Canadian enhanced salmon production, 1977-1999. (NPAFC Doc. No. ). p. Dept. of Fisheries and Oceans, Habitat and Enhancement Branch, Vancouver, B.C. V6B 5G3.

The Salmonid Enhancement Program in British Columbia, Canada was undertaken in 1977 to rebuild stocks and increase catch through the expanded use of enhancement technology. The program is now comprised of nearly 300 projects and produces 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 (*Salmo 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 releasing fewer than one thousand. Steelhead and cutthroat data are not included in this report as their assessment is a provincial responsibility.

## **Introduction**

The Salmonid Enhancement Program (SEP) in British Columbia, Canada was undertaken in 1977 to rebuild 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, generate jobs and 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 which had began operation in the early 1970's. SEP was combined with Habitat Management in 1995 to form the Habitat and Enhancement Branch (HEB). The program is now comprised of nearly 300 projects throughout British Columbia and produces 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 (*Salmo clarki*).

Projects include hatcheries, fishways, spawning and rearing channels, and small classroom incubators, ranging in size from spawning channels releasing nearly 100 million juveniles annually to school classroom incubators releasing fewer than one thousand juveniles. Projects are operated by HEB staff or contracted community and native groups, as well as by volunteers with some HEB support. As many as 10,000 volunteers may participate in the program in any given year. The focus is also on restoring and improving fish habitat. SEP works with First Nations, industry, community groups and other government agencies to design and implement habitat projects.

A public involvement and education program offers technical support and funding to volunteers who operate community salmon enhancement and stewardship projects, training and supporting the public to actively monitor, protect, and improve fish habitats. SEP also developed educational packages to teach children about salmon and the need to protect habitat and watersheds.

## **Methods**

Juvenile salmonids are reared to various release stages depending on the species and enhancement technology employed. Chum and pinks are released either unfed after emergence from channels or incubation boxes or as fed fry after one month of feeding. Coho are released as fed fry after 3 to 5 months of rearing or as smolts after one year of rearing. The majority of sockeye are released as unfed fry after emergence from channels, although a small number are hatchery incubated and short-term reared. Sockeye are also enhanced through lake fertilization programs, migrating from the lake after one year of rearing. For chinook, coastal stocks are released after 3 to 4 months of rearing, while interior stocks are frequently reared for one year to the yearling stage. The latter are a very small part of the chinook program and releases are not tabulated separately in this report. Releases from hatcheries are usually enumerated by subtracting egg and fry mortalities from the egg number while releases from manned channels are estimated through proportional sampling of the outmigrants.

Annual egg and release targets for hatcheries are set pre-season for each stock, in consultation with project managers, stock assessment biologists and harvest management biologists. Factors such as potential adult production (based on previous average survival rates), species interactions, effect on existing stocks, harvest concerns, habitat capacity and project capacity are taken into account.

Estimates of enhanced contribution and survival rates of chinook, coho, and chum salmon are based on marking a portion of the fry released and recovery of these marks in the fisheries and escapement. Marking occurs at the project prior to release, while recovery takes place through coastwide sampling programs in the sport and commercial fisheries (Kuhn, 1988; Kuhn et al., 1988) and through recovery programs on the spawning grounds or at the project. Sockeye and pinks are not currently marked, although the latter were in the past.

Mark type is dependent on the species, with coded wire tags used for chinook, coho and some chum stocks, and finclips for other chum stocks. For large production groups, a proportion of the release group is marked and are assumed to represent the unmarked fish. Smaller experimental groups to assess various strategies within a project may have a greater proportion of the release marked but are not considered to represent production. Beginning in 1996, coho from southern B.C. production facilities were marked with a fin clip to allow for the possibility of a selective hatchery mark fishery.

Attempts are made to assess all stocks routinely but some enhancement projects and species are rarely or never assessed directly because of their small size or logistical constraints. Certain stocks have been identified as indicator stocks, and their production is marked annually. These sites conduct rigorous escapement sampling and estimation programs. Survival and exploitation rate estimates for these projects are used to represent parameters for other stocks, both wild and enhanced, and to show trends over time.

There are fewer projects enhancing sockeye and pinks. Because neither species is now marked, production is estimated using run reconstruction or average predicted survival rates.

## **Results**

Table 1 shows releases for 1977 - 1998 brood years from hatcheries and manned spawning channels operated by HEB staff or contracted community and native groups. Estimates of production from unmanned channels, overwintering ponds, lake enrichment programs and other habitat restoration projects are not included, although they were included in previous reports. Steelhead and cutthroat data are not included as their assessment is a provincial responsibility. Locations of facilities included in Table 1 are shown in Figures 1a, 1b and 1c.

Total releases approximately doubled between 1977 and 1988 brood years, with the largest numerical increase for chum fry. In 1995 and 1996, poor marine survival for southern B.C. chum led to decreased escapement, resulting in lower production. Lower harvest rates and good escapement for lower Fraser River chum led to reductions in egg targets for 1998. Full production for chinook and coho smolt releases was reached in the early to mid 1980s. In recent

years increased effort was made to rebuild severely depressed stocks, including upper Skeena and Thompson coho. Unfed pink releases fluctuate annually because of the natural cycles in the Fraser River and the phasing in and out of pink projects since the 1988 brood year. Pink fed fry releases peaked in 1985 at more than 5 million but have since declined because of reduced emphasis on this strategy. Since 1994, disease mortality for some years has affected spawning success for Skeena River sockeye channel production. Production from Fraser River sockeye channels fluctuates because of natural cycles.

HEB continues to implement habitat restoration and stewardship projects throughout British Columbia. Projects are cooperative programs in partnership with other governmental and non-governmental agencies and include constructing side-channels, increasing water flows, stabilizing stream banks, enriching nutrient poor lakes and rivers, and rebuilding estuary marshes. Three sockeye salmon nursery lakes on Vancouver Island were fertilized in 1998.

In 1998 and 1999, concern for Upper Skeena and Thompson River wild coho stocks constrained the harvest of all species. The entire coast was managed on the basis of Upper Skeena and Thompson River coho. No fishing was permitted in areas and times where these stocks were prevalent and selective fishing gear was required in all fisheries. Fishing for other species was permitted in areas and times where these stocks were not prevalent, with retention of coho permitted only in extreme terminal areas on hatchery stocks. Many of the fisheries which did occur were focussed on enhanced stocks.

## **Summary**

Data are presented for releases by brood year, species and release stage for Enhancement Operations and Community Economic Development Program facilities. Since 1998, Fisheries & Oceans has implemented more conservation based management of salmon fisheries. Many fisheries are being directed towards enhanced stocks.

Figure 1a Locations of selected British Columbia, Canada enhancement facilities.

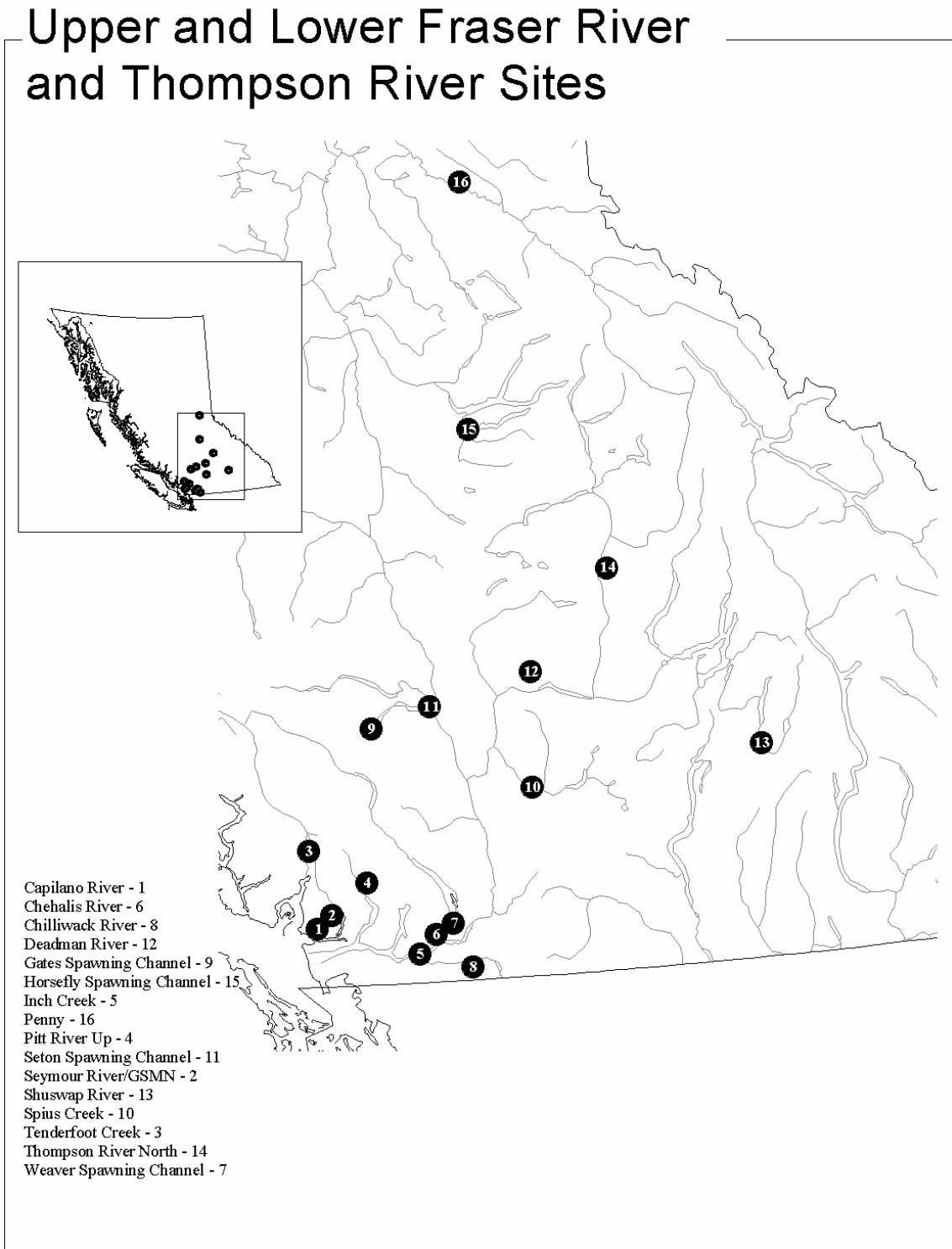


Figure 1b Locations of selected British Columbia, Canada enhancement facilities.

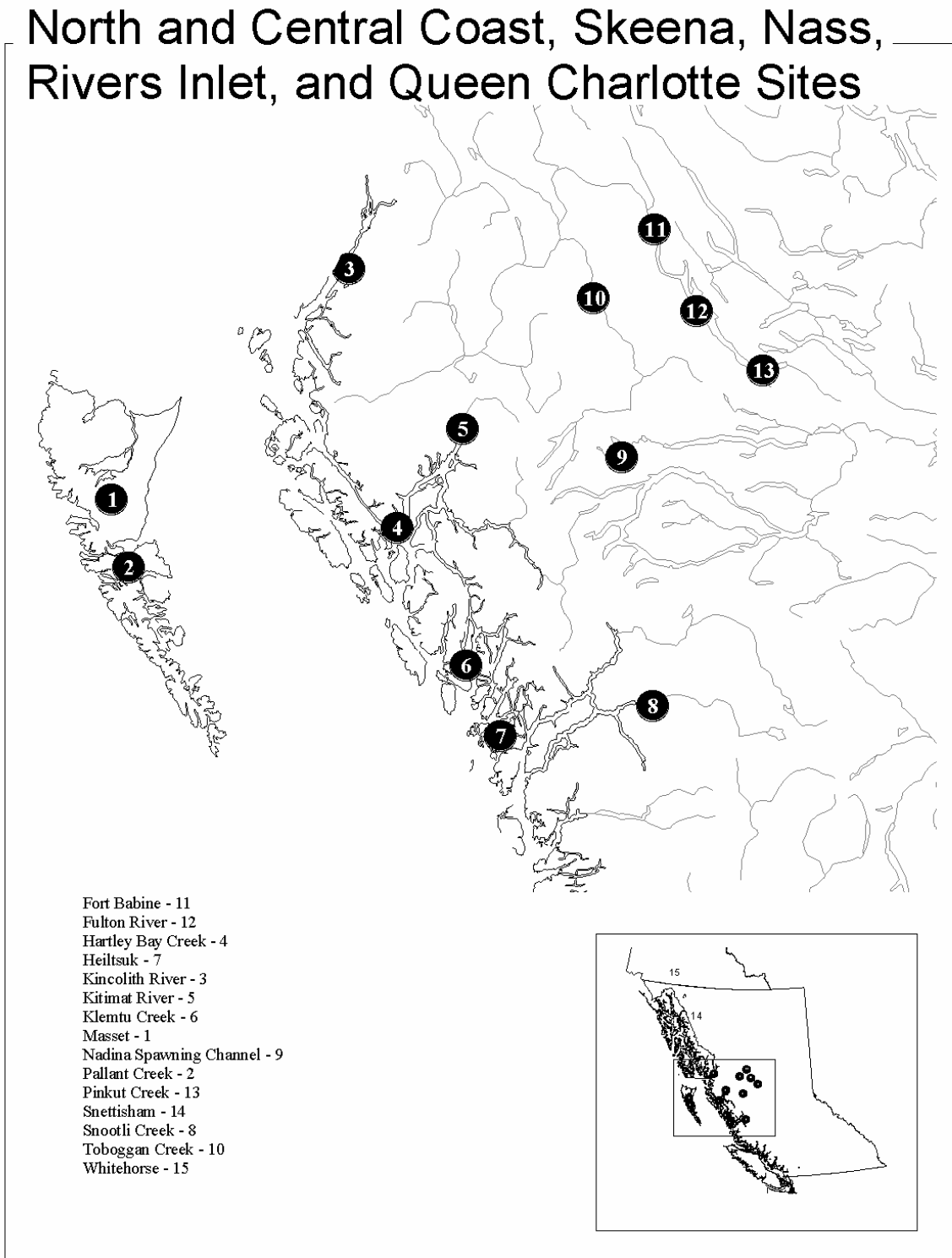


Figure 1c Locations of selected British Columbia, Canada enhancement facilities.

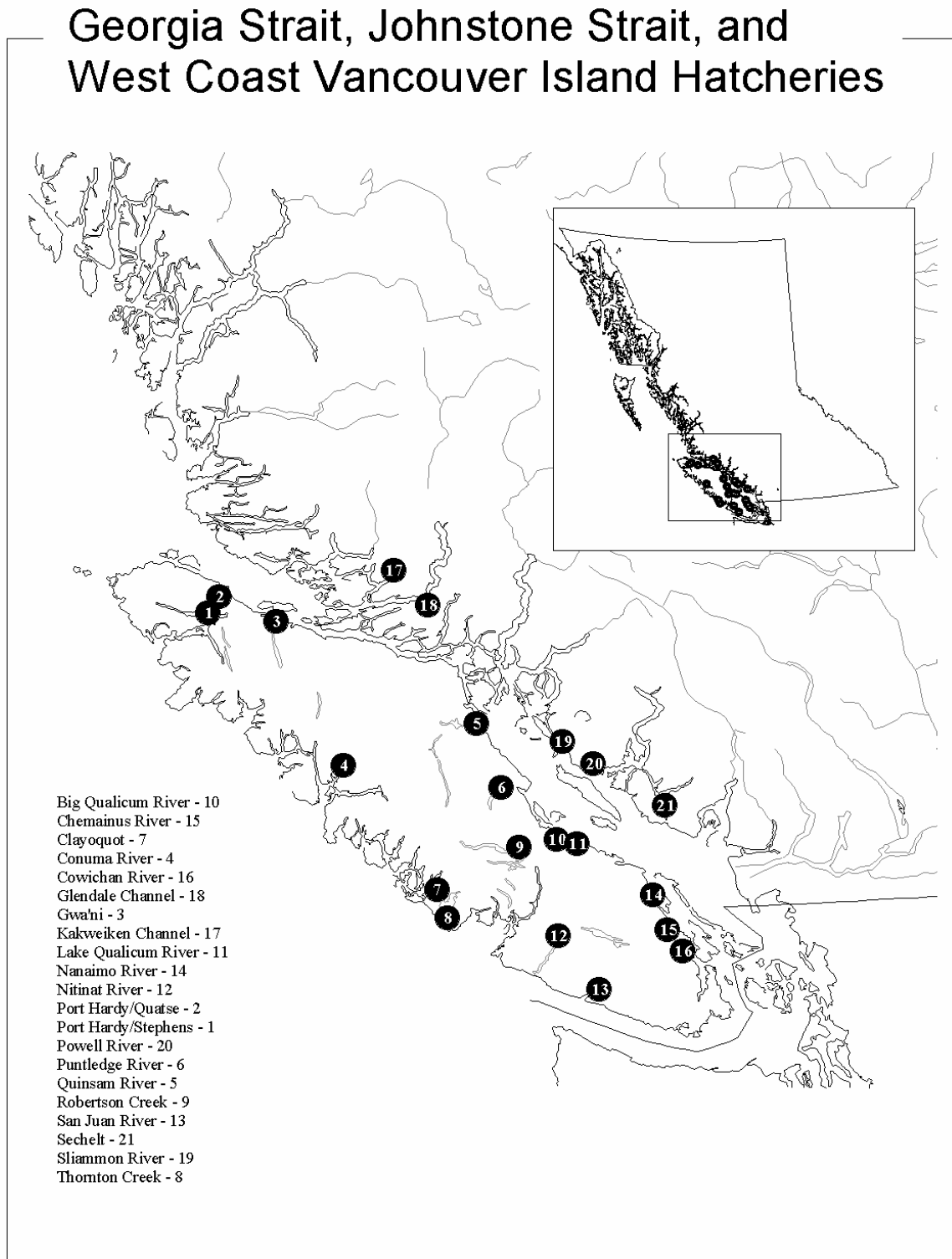


Table 1. Releases of juveniles from HEB hatcheries and manned channels in British Columbia Canada (not including those released from Public Involvement Projects).

Brood Year	Chinook	Chum		Coho		Pink		Sockeye
		Unfed	Fed	Fry	Smolt	Unfed	Fed	
1977	13,620,370	52,127,027	1,904,625	2,073,819	2,984,462	31,029,220		191,179,000
1978	14,253,404	48,218,296	5,535,566	1,012,721	3,741,951	750		133,739,000
1979	16,379,080	69,550,228	9,191,947	3,691,819	4,963,264	26,145,904	358,639	200,179,521
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
1981	17,563,349	50,709,042	68,980,710	7,311,022	4,889,684	33,113,088	492,034	170,814,370
1982	24,854,529	86,930,258	69,365,130	10,773,108	6,898,222	2,510,301	423,038	194,054,919
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
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
1985	42,736,623	41,614,811	102,464,677	8,852,842	9,720,856	25,432,597	5,057,021	157,434,930
1986	53,815,001	96,413,382	85,842,800	11,505,565	10,087,259	13,740,312	4,509,098	180,106,075
1987	63,631,981	101,859,170	75,979,591	8,064,239	9,534,951	43,696,480	4,807,689	122,471,589
1988	64,254,578	113,649,528	87,928,664	7,701,263	11,168,846	34,245,812	2,827,349	198,725,634
1989	63,254,499	83,288,150	92,214,006	9,637,486	11,705,728	48,240,457	2,884,163	206,752,792
1990	66,114,433	94,789,499	94,759,699	8,522,910	12,115,301	87,447,634	1,023,076	223,080,058
1991	59,326,978	79,481,997	96,839,355	9,421,861	10,700,087	54,216,640	1,584,525	227,135,058
1992	57,947,746	113,799,377	89,286,432	6,367,148	10,370,043	14,074,137	1,781,339	233,579,579
1993	50,834,933	101,859,532	93,399,435	6,477,421	10,735,588	36,840,352	1,576,168	179,045,418
1994	53,344,098	85,693,766	103,998,196	10,546,670	10,646,445	8,794,240	1,981,042	132,530,977
1995	45,205,507	33,590,212	87,665,283	8,197,903	11,306,971	32,476,878	2,001,615	77,956,790
1996	57,580,439	16,928,042	93,094,003	5,769,716	11,804,961	11,255,228	1,472,567	254,943,503
1997	49,798,448	45,470,998	104,479,836	5,212,183	11,563,045	34,389,505	1,640,496	84,178,738
1998	53,586,088	77,036,805	76,909,529	8,441,451	10,546,048	12,891,783	150,482	135,032,533

### LITERATURE CITED

Kuhn, B. R. 1988. THE MRP-REPORTER PROGRAM: A data extraction and reporting tool for the Mark Recovery Program database. Can. Tech. Rep. Fish. Aquat. Sci. 1625: 145 p.

Kuhn, B. R., L. Lapi, And J. M. Hamer. 1988. An introduction to the Canadian database on marked Pacific salmonids. Can. Tech. Rep. Fish. Aquat. Sci. 1649: viii + 56 p.