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**Enhanced Salmon Production in British Columbia, Canada  
1977 - 1998**

by

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## ABSTRACT

Program Coordination and Assessment Division. An assessment of Canadian enhanced salmon production, 1977-199. (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.

This report tabulates release data for the program by species and stage. 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. It 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, habitat improvements, flow control works, lake fertilization, 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.

## **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 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 releases also include juveniles estimated to be incremental due to lake fertilization programs. 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 enumerated by subtracting egg and fry mortalities from the egg number while releases from channels are estimated through proportional sampling of the outmigrants. HEB also has a number of unmanned channels, overwintering ponds and other habitat restoration projects. Release data is not included for these projects. Steelhead and cutthroat data are not included in this report as their assessment is a provincial responsibility. Locations of facilities are shown in Figures 1a, 1b and 1c.

Annual egg and release targets 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. Production targets are being reviewed, taking into account changes to fisheries management, recent marine survivals and budgetary constraints. Final targets for 1999 are not yet available.

Figure 1a. Locations of selected projects for SEP, British Columbia, Canada.

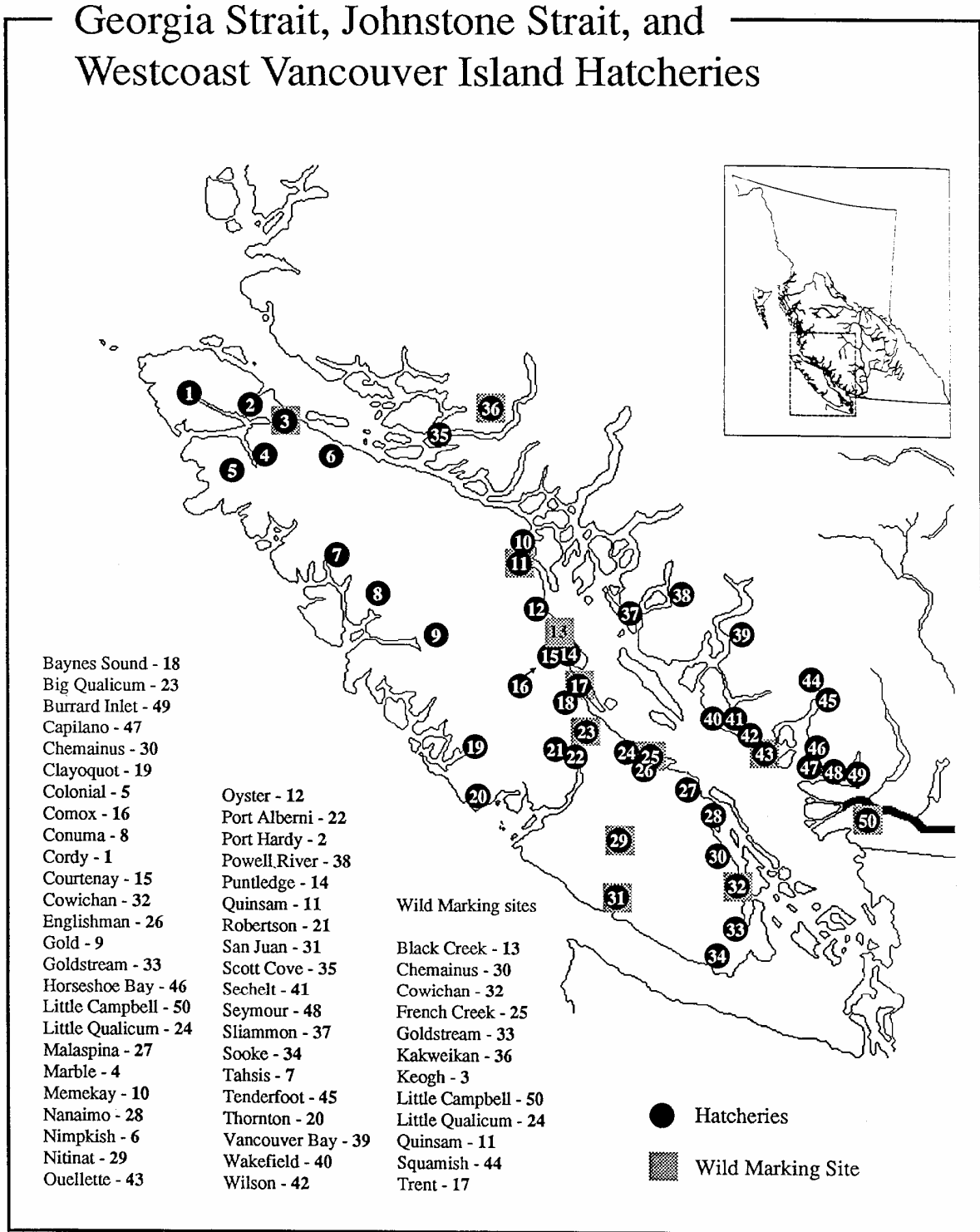


Figure 1b. Locations of selected projects for SEP, British Columbia, Canada.

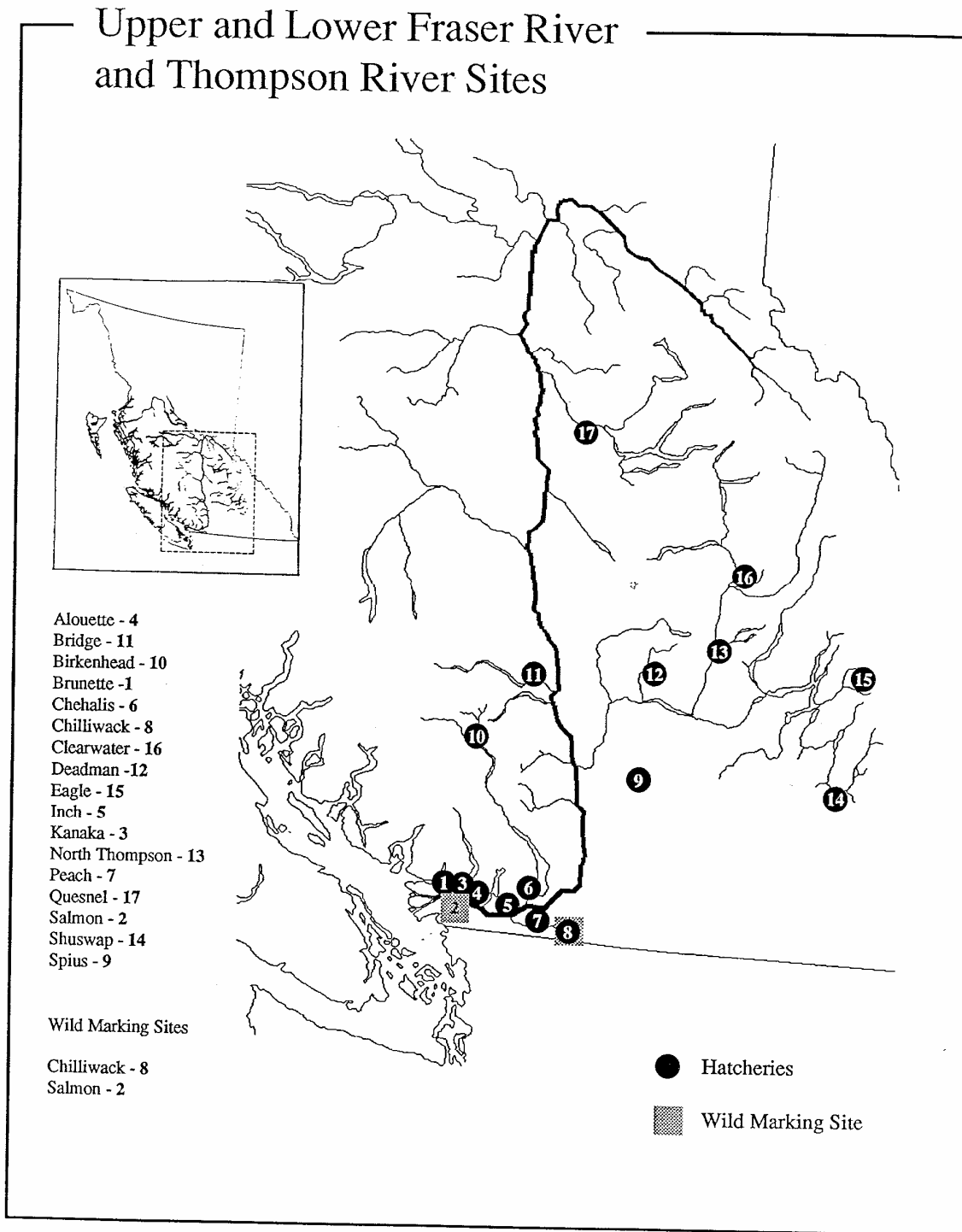
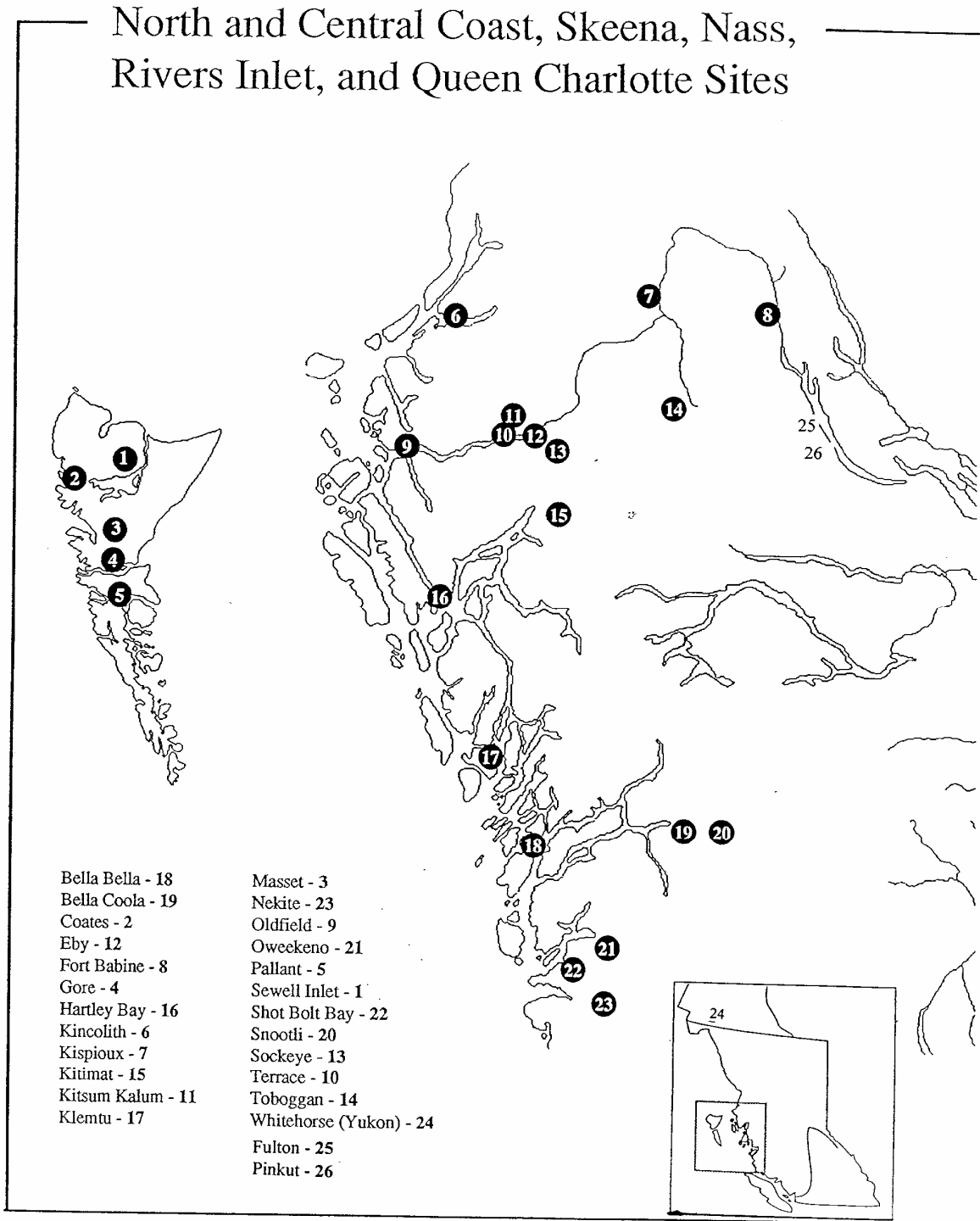


Figure 1c. Locations of selected projects for SEP, British Columbia, Canada.



Estimates of enhanced contribution and survival rates of chinook, coho, and chum salmon enhancement projects 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 dead recovery programs in the escapement 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 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 SEP program releases for 1977 - 1997 brood years. 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. Survivals improved for 1997 return year. Full production for chinook and coho smolt releases was reached in the early to mid 1980s and releases have been relatively stable since that time, averaging 51.6 million and 11.8 million respectively for the last five brood years. Unfed pink releases fluctuate from year to year 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.

In 1998, 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 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 and the Lake Enrichment Program. In 1998, Fisheries & Oceans moved toward a more conservation based management of salmon fisheries. Many of the fisheries which did occur were directed towards enhanced stocks.

**Table 1: Releases of juveniles from HEB facilities in British Columbia Canada.**

Brood Year	Chinook		Chum		Coho		Pink		Sockeye*
	Unfed	Fed	Unfed	Fed	Unfed	Fed	Unfed	Fed	
1977	13,620,370	52,127,027	1,904,625	2,073,819	2,984,462	31,029,220	0	201,309,000	
1978	14,253,404	48,988,753	5,535,566	1,016,721	3,747,251	750	0	141,574,350	
1979	16,379,080	73,460,748	9,191,947	3,720,519	4,980,154	26,145,904	358,639	220,701,122	
1980	19,850,845	76,533,396	29,684,300	2,449,038	5,270,862	4,705,834	1,859,631	199,054,901	
1981	17,428,192	60,912,404	68,980,710	7,316,822	4,932,174	33,113,088	492,034	211,604,372	
1982	24,854,529	97,024,858	69,365,130	10,806,784	6,944,312	2,510,301	423,038	218,317,433	
1983	29,374,066	92,812,179	85,579,589	8,973,671	13,627,953	27,341,916	1,521,896	144,301,195	
1984	34,864,768	63,995,445	103,779,630	13,188,798	12,054,778	3,783,368	2,296,285	254,991,214	
1985	42,736,623	55,859,711	102,464,677	9,219,283	9,800,761	26,182,597	5,057,021	175,808,962	
1986	53,815,001	107,035,482	85,842,800	11,846,840	10,201,914	14,190,312	4,509,098	200,924,044	
1987	63,693,726	120,271,363	75,979,591	8,120,203	9,554,848	44,781,230	4,807,689	158,654,299	
1988	64,465,641	132,678,547	88,028,664	8,343,731	11,336,198	14,783,123	2,827,349	226,805,181	
1989	63,534,499	108,091,672	92,187,205	10,777,378	11,889,243	48,758,930	2,884,163	221,932,392	
1990	66,461,805	121,271,047	94,709,699	10,014,313	12,330,486	20,587,839	1,023,076	248,861,158	
1991	59,540,198	103,119,539	96,692,355	10,967,974	10,947,650	53,544,698	1,584,525	267,228,098	
1992	57,988,721	143,060,171	88,636,879	8,022,311	10,639,038	17,459,561	1,781,339	262,830,119	
1993	51,094,315	130,470,607	91,522,640	8,146,746	11,021,593	39,740,354	1,576,168	187,259,518	
1994	54,176,102	120,013,220	103,929,196	12,255,606	10,921,771	10,694,240	1,981,042	165,415,488	
1995	45,370,507	96,252,287	87,530,283	8,801,855	11,640,301	34,777,878	2,001,615	115,332,893	
1996	57,805,915	82,254,542	92,955,268	6,190,615	12,126,157	13,307,805	1,472,567	261,562,303	
1997	49,696,436	118,767,798	104,475,364	5,639,258	11,792,951	35,174,505	1,640,496	105,818,638	

\* includes lake enrichment projects for all years except 1996 and 1997 broods not yet available

### LITERATURE CITED

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