Scientific Excellence • Resource Protection & Conservation • Benefits for Canadians
Excellence scientifique • Protection et conservation des ressources • Bénéfices aux Canadiens

Production of Chinook and Coho Salmon From British Columbia Hatcheries, 1971 Through 1989

C.L. Cross[1], L. Lapi[2] and E.A. Perry[1]

[1] Department of Fisheries and Oceans
555 West Hastings Street
Vancouver, B.C. V6B 5G3
[2] Department of Fisheries and Oceans
Pacific Biological Station
Nanaimo, B.C. V9R 5K6

1991

Canadian Technical Report of
Fisheries and Aquatic Sciences
No. 1816

Fisheries and Oceans Pêches et Océans

Canada

Cat. No. Fs97-6/0000E ISSN 0706-6457

Correct citation for this publication:

Cross, C. L., L. Lapi, and E. A. Perry. Production of chinook and coho salmon from British Columbia hatcheries, 1971 through 1989. Can. Tech. Rep. Fish. Aquat. Sci. 1816: 48 p.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF APPENDICES

ABSTRACT

Cross, C. L., L. Lapi, and E. A. Perry. Production of chinook and coho salmon from British Columbia hatcheries, 1971 through 1989. Can. Tech. Rep. Fish. Aquat. Sci. 1816: 48 p.

This report reviews the release, contribution and survival data for chinook and coho released from British Columbia hatcheries. Data sources and methods used in B.C. are described and a brief background of the development and organization of hatchery operations is provided. Juvenile release data are tabulated in summary format for each brood year, production area and stage at release and adult catch data are tabulated by fishery and recovery year. Survival trends for enhanced stocks are examined over time and, for select coho stocks, with reference to comparable wild stocks.

Key words: hatcheries, enhancement, chinook, coho, juvenile releases, fish production, catch contribution, survival

RÉSUMÉ

Le présent rapport examine les données sur la libération, la contribution et la survie des saumons quinnat et coho mis en liberté à des piscifactures en Colombie-Britannique. Les sources des données et les méthodes utilisées en C.-B. sont décrites, on présente un bref aperçu du développement et de l'organisation d'une piscifacture. Les données sur la libération des juvéniles sont présentées sous forme de tableau résumé pour chaque année de génération, zone de production et état à la libération; les données sur les prises d'adultes sont présentées sous forme de tableau, par pêche et année de récupération. On examine les tendances de survie en fonction du temps pour les stocks mis en valeur et pour certains stocks choisis de coho, au regard de stocks sauvages comparables.

Mots clés: piscifacture, mise en valeur, quinnat, coho, libération de juvéniles, production de poissons, contribution aux prises, survie

I. Introduction

This report reviews the production of chinook and coho from British Columbia (B.C.) hatcheries. Assessment of production involves the measurement of juvenile releases, adult recoveries and their inter-relation. Data sources and methods used in B.C. are described. Juvenile release data are tabulated in summary format for each brood year, production area and stage at release and adult catch data are tabulated by fishery and recovery year. As well, survival of juvenile chinook and coho salmon for each hatchery are presented by brood year with detailed discussion on the reliability of total survival data. Survival trends for enhanced stocks are examined over time, and with reference to comparable data for wild stocks of coho salmon. No comparable data are available for wild stocks of chinook.

To provide the reader some background we describe briefly the development and organization of hatchery operations in B.C., the rationale for production levels, fishculture methods, release strategies and expected results. Stream improvement programs, flow control and fishway works and incidental yield of coho in channels built primarily for chum or pink all add to the productivity of chinook and coho. These enhancement activities are not accounted for in this report.

Some of the data presented in this report are considered preliminary and portions of it (such as escapement data) are known to be incomplete. The effect of variable data quality and data gaps on estimations of contribution, survival and exploitation rates is discussed.

II. Background: Chinook And Coho Hatchery Development And Strategies In B.C.

A. Development And Organization Of Hatchery Operations

Hatchery production of chinook and coho salmon in B.C. began in the late 1960's with experimental work at the Big Qualicum River Development Project. Hatchery production on a routine basis dates from 1971 when Big Qualicum and Capilano hatcheries began operating. There were 11 chinook and coho hatcheries by 1977, the year the Salmonid Enhancement Program (SEP) began. Many new facilities have been funded through SEP since 1977 with chinook juveniles released from 81 facilities in 1988 and juvenile coho released from 218 facilities (Appendix A).

SEP is comprised of two operational divisions. The Enhancement Operations Division runs large government-owned hatcheries and spawning channels directly or through contract to the private sector while the Community Programs Division is responsible for operation of hatcheries developed in cooperation with community and public groups as well as some unmanned spawning and rearing channels. In

addition, Development Division operates some channels and fishways. Identification of the operational group for each hatchery with chinook or coho production capacity is included in Appendix A.

Production highlights in recent years include an emphasis on expanded chinook enhancement in the lower Georgia Strait area as an integral component of the Department's chinook rebuilding program and the use of several new technologies for enhancing chinook salmon. These include rearing to the smolt stage in lake pens, short-term rearing of smolts in sea pens and rearing of smolts to maturity in sea pens to increase egg availability.

The locations of B.C. chinook and coho hatcheries which were operational for the 1988 brood year are illustrated in Appendix B. Included in these figures is the Unit responsible for operation and the species enhanced at each facility. Small coho hatcheries with production capacity of less than 2000 adults are not shown.

B. Production Strategies

Production targets for B.C. hatcheries are based primarily on fisheries management objectives for harvest and conservation and on historical species balance within river systems. Hatcheries in B.C. are intended to meet management objectives by:

- increasing catch of a stock above natural capacity, or
- increasing escapement of a stock to target levels, or
- supplementing, but not comprising a major portion, of a stock's production.

Most larger hatcheries produce a number of species reflecting the historical abundance of each species. Enhancement of a species is also done to mitigate possible interception in fisheries directed at the predominant species in a system or region. Stocks in neighbouring streams of the same species as the primary targeted species in a river are often enhanced to further increase catch or to conserve spawning populations at optimum levels.

Most hatcheries enhance stocks from the watershed on which they are located. In addition, many hatcheries, especially those built during the past ten years, are central facilities for enhancement of many different stocks within a region. Quesnel Hatchery, for example, enhances chinook stocks spread over an area larger than the Queen Charlotte Islands. Transplants from hatcheries to unused streams which may or may not have once supported the species are done when necessary and practical.

Fishculture methods used for chinook and coho salmon in B.C. have developed from methods established in the United States during the 1960's. In general, adults are captured and spawned; eggs are incubated to the swim-up fry stage in vertical-stacked trays or, in some cases, incubation boxes; fry are released unfed or transferred to rearing ponds for feeding; and finally, reared fish are released

after some period of feeding, as fed fry or smolts. A description of currently used incubators, rearing ponds, other hatchery equipment and facility and fishculture criteria may be found in Shepherd (1984).

Release strategies for juvenile chinook and coho from hatcheries are diverse and are designed to maximize production and conform to natural life histories. Smolt releases account for most hatchery contribution to adult catch and escapement but pre-smolt releases, especially of coho salmon, are also numerically large. Smolt releases are usually to sections of river accessible to returning adults. Pre-smolt releases of unfed or fed fry are made to sections of accessible river areas considered underseeded by natural fry or to inaccessible sections of river to take advantage of underutilized rearing habitat. The latter method, colonization, is done in consultation with the provincial Fisheries Branch given the presence of resident trout and other species in many such locations.

Release timing and body size targets for smolts are hatchery specific and reflect accumulated knowledge based on results of past releases. There have been several studies to evaluate release criteria for smolts on a detailed level in cooperation with research staff (e.g. Bilton et al., 1982, 1983; Bilton, 1984) and on a gross level within SEP involving mark release and recovery. While much of these data remain unpublished, they are available through the Mark Recovery Program (MRP) database and are used routinely for scheduling hatchery operations. Less data are available for pre-smolt release strategies but there has been increasing interest during the past five years with several studies now in progress. Season (early summer versus fall), body size, stocking density and location are the major criteria of concern for pre-smolt releases.

Expectations for survival from release of chinook and coho juveniles to the catch and escapement are highly dependent on species, stage at release and geographic production area (Table 1). They are derived from past averages where sufficient data are available and from comparable releases for sites without sufficient data.

III. Data Sources, Quality And Methods

A. Data Handling

Enhancement Operations and Community Programs divisions use different systems and databases for storing juvenile and adult biological and enumeration data although amalgamation is in progress.

Table 1. Expected survival of hatchery released chinook and coho juveniles to the catch and escapement.

			SURVIVAL (%)				
STAGE AT RELEASE	TIME OF RELEASE	SIZE (g) AT RELEASE	NORTH COAST	WEST COAST VAN. IS.	GEORGIA STRAIT	LOWER FRASER	UPPER FRASER
Chinook							
Fry	Spring	Unfed	.20	.20	.20	.20	-
Fed Fry	Spring	< 3	.75	.75	.75	.75	.25
Fingerling	Fall	5 - 8	1.0	-	-	-	-
Fingerling	Fall	8 - 12	1.5	-	-	-	1.5
Fingerling	Fall	> 15	2.0	-	-	-	-
Smolt 0+	Spring	> 3	1.1 - 1.2	1.4	1.7 - 2.0	1.7	.75
Smolt 1+	Spring	15 - 20	2.0	-	-		1.5
Smolt 1+	Spring	30	2.6	2.6	2.6	2.6	1.8
Seapen Smolt 0+	Spring	> 3	1.2	-	1.7	-	-
Seapen Smolt 1+	Spring	> 45	3.0	-	3.0	-	-
Coho							
Fry	Spring	Unfed	.8	.8	.8	.8	.8
Fed Fry	Spring	< 1.2	1.2	1.2	.8 - 1.2	1.2	1.2
Fed Fry	Spring	< 5	2.0 - 2.5	2.0 - 3.0	1.0 - 2.0	2.0	2.0
Fingerling	Fall	> 5	3.0	3.0	2.0 - 3.0	3.0	3.0
Smolt 1+	Spring	> 10	10.0	5.0 - 10.0	10.0	10.0	10.0

Note: Entries are made only for those prodution areas where a particular release strategy is used.
A range of values reflects different estimates for sub-areas within the geographic zone.

For juvenile data, both divisions use spreadsheet templates for maintaining detailed fish culture records at the individual hatcheries. Juvenile release data and mark information for each release are entered into the MRP database. Each group of fish released is considered to be one of three types; unassociated (i.e. no portion of the release was marked), represented by a coded-wire tag (CWT), or represented by a fin clip.

For hatchery return data, we use custom software and dBase IV for storing biological sample data. Where available, adult enumeration data is entered directly into the MRP database. Commercial and sport fishery data are also entered into the MRP database. Reporting and analysis are described by Kuhn (1988). Release and recovery data are forwarded to the Regional Mark Processing Center in Portland, Oregon.

Data from the Enhancement Operations and Community Programs divisions are combined in the EPIC (Enhancement Planning and Information Control) database. This database provides project level information on juvenile releases, production targets, facility capacities, adult recoveries, and program costs.

B. Design Of Juvenile Chinook And Coho Marking Studies

CWT marking and recovery is the primary tool for assessment of chinook and coho hatchery stocks in B.C. and the U.S. Marking studies are designed to determine survival and contribution of a particular group of fish released from enhancement projects or to determine the relative performance of experimental groups of fish. For actual examples of marking studies done in B.C. hatcheries see Cross and Perry (1985). Marking program logistics follow PMFC protocol (PMFC, 1982) as much as possible.

Marking requirement calculations are based on the hypergeometric distribution. Single mark group studies to assess survival and contribution are designed to provide 95 percent confidence with a 10 percent confidence interval in the estimated catch of all (not each) age classes. Multiple mark group studies to assess relative survival of experimental lots are designed to demonstrate 25 percent differences in survival at confidence levels of 95 percent for Type 1 and Type 2 errors and a 10 percent confidence interval. Typical mark release groups are 10,000 to 50,000 for coho smolts and 25,000 to 100,000 for chinook smolts.

In reality, it is not always possible to mark ideal numbers of fish due to logistical or cost constraints. In many cases we decide to proceed with reduced marking programs on the grounds that information in which we have 90 percent confidence, or even 80 percent confidence, is better than no information.

C. Unassociated Releases

There are a large number of releases of juvenile chinook and coho salmon in B.C. each year which are not represented by CWT's because there is no portion of the release marked. These releases are termed unassociated releases. While most production groups from large hatcheries are directly associated with a CWT release group, many releases from small hatcheries are not. Because it is not possible to directly calculate the contribution of such releases, we have used comparable marked releases to estimate the survival and contribution of unassociated releases to each Canadian fishery by recovery year. Full details of the method and data used can be found in Appendix C. Work is underway on a new estimation method for unassociated releases. It will scan the MRP release file to find tag groups which are most comparable to the unmarked group according to the degree of similarity in release variables. When this method is finalized, estimates of unassociated contribution may differ from those published here.

D. Data Quality And Gaps

Methods for enumerating unmarked and total release numbers vary from facility to facility. As a general rule, the tagged fish in CWT groups are enumerated during the tagging operation using the automatic tag counter. Finclipped fish are enumerated during clipping using tally counters. Total releases are usually calculated from a book balance (number of eggs taken minus cumulative incubation and rearing mortality) or estimated by a Petersen mark-recapture procedure. These methods are known to be inaccurate and biased (McLean et al, 1984; English et al., 1988). The Petersen method has not been used in recent years because of the difficulty in meeting all of the assumptions regarding random sampling from hatchery rearing containers.

Release statistics for the number of marked fish are very accurate. It should be emphasized that survival and harvest rate estimates are independent of the number of unmarked fish released, that is, they depend only on the release and recovery of marked fish. Consequently, the accuracy of survival and harvest rate statistics primarily reflect the accuracy of catch and escapement data.

The numbers of unmarked fish (associated with a CWT release group) released from hatcheries are not as well known as numbers of marked fish. Since these numbers are required to expand mark recovery data to total production they reduce the accuracy of contribution estimates.

For unassociated releases, contribution is estimated based on survival rates observed for comparable marked releases. This is another source of error in contribution estimates.

There are concerns related to whether marked fish truly represent unmarked fish from the same population in terms of survival, catch distribution and escapement distribution. There are also problems associated with CWT loss. These concerns have been subject to general discussion (PMFC, 1982) and to detailed review for B.C. chinook and coho hatcheries (English et al., 1988).

E. Escapement Enumeration And Sampling

Hatchery fish returning to fresh water may be captured for brood stock or spawn naturally. Fish captured for brood stock or attracted into a hatchery are enumerated and sampled thoroughly although there have been recent concerns about missed marks (K. Wilson and C. Cross, unpublished data). Enumeration of naturally spawning fish may be accurate, especially in systems with a counting fence or if an adult mark-recapture study is done, but otherwise is considered inaccurate. Mark sampling may be done but is not routine for naturally spawning fish.

All chinook and coho mark recovery data are entered into the MRP database. However, only those recovery data for accurately enumerated components of the escapement are expanded to total run size to estimate returns of marked and enhanced fish. In general, all fish captured for brood stock or attracted into a hatchery are accounted for. On the other hand, mark sample data for naturally spawning fish are often not expanded to total run size because of lack of confidence in the estimate of total escapement.

There are initiatives to improve estimates of the naturally spawning populations in many enhanced streams and to account for mark returns in this component.

Mark rate sample requirements provided to hatchery staff are based on the binomial distribution and are calculated by tag code to provide 90 to 95% confidence that the measured mark rate will be within 10% of the true value. This is not always possible as there may be fewer marked fish returning than required for this accuracy level (typical for chinook, in which case all fish are sampled), or sample levels required to obtain the desired number of recoveries for a low incidence CWT group may necessitate sample sizes in excess of program resources.

F. Catch Enumeration And Sampling

Mark incidence and catch enumeration data quality range from generally good for the commercial fisheries to almost non-existent for native food fisheries. The general consequence of incomplete sampling is an underestimation of enhanced chinook and coho contribution and survival rate.

1. Canadian Commercial Fisheries

Catch regions consist of sets of statistical areas combined with a gear type; catch estimates for the component statistical areas are combined to ensure an appropriate catch sample ratio. Approximately 20% of the landings for each catch region and week are sampled directly for marks. Catch regions were created in part to resolve the problems that can arise when a vessel fishes across several statistical areas as it is not possible to assign catch to a specific area.

In net fisheries, juvenile chinook catches are often underestimated, resulting in a subsequent underestimation of hatchery chinook contribution and survival. As well, gillnet and seine catches are often mixed on packer vessels so estimation of mark recoveries must be done on a mixed gear basis. Fraser River net fisheries are exceptions to this.

2. Georgia Strait Sport Fishery (GSSF) And Other Sport Fisheries

At present there is no direct sampling of sport fisheries for CWT's in B.C. Instead, approximately 5% of the GSSF is sampled for mark incidence rate by month. The heads are not removed during this sampling but are obtained by voluntary returns from sport fishermen. Procedures for estimating mark returns are described in Kuhn et al., 1988.

Seasonal creel surveys are also conducted in some other sport fisheries. These surveys are often sporadic and the data incomplete and it is often necessary to estimate the total number of marks using mark return rates observed in the Georgia Strait sport fishery. This return rate, known as the awareness factor, is highly variable in time and area within Georgia Strait and causes uncertainty in estimates of catch and survival.

3. Native Food Fisheries

With a few minor exceptions, the native food fishery is not currently sampled for marks. There is also no consistent method for estimating the catch in this fishery. As a consequence, it is not possible to estimate SEP contribution.

4. U.S. Data

U.S. commercial fisheries are sampled in a similar way to Canadian commercial fisheries but the details vary from agency to agency. There has been an exchange of both catch and mark recovery information with the U.S. for many years, but only recently under the Pacific Salmon Treaty has there has been an effort to exchange sufficient data to assess its quality.

5. Data Methods And Status

All data necessary for the estimation of survival rate and catch of marked and unassociated releases were obtained from the MRP database. Total release data by stage originated from the EPIC database.

Data for survival calculations included preliminary data to 1989 for Canadian commercial and sport fisheries, Washington and Alaska fisheries and Canadian escapement. Survival estimates for brood years with returns after 1989 are incomplete.

Sport recoveries for Georgia Strait were expanded using GSSF creel survey data for the months of May through September and an average of those months for the remaining months of the years. For years prior to the operation of the creel survey (pre-1980) and for sport areas other than Georgia Strait, an expansion factor of 4 (i.e. awareness factor of 0.25) was used.

The production area and catch area groupings used throughout the text include the following:

Production Areas

North	-	Nass, Skeena, Queen Charlotte Islands, North Coast, Central Coast, Rivers Inlet
Inside	-	Johnstone Strait, Georgia Strait Vancouver Is., Georgia Strait Mainland, Lower Fraser
West Coast	-	North West Vancouver Island, South West Vancouver Island
Upper Fraser	-	Thompson, Upper Fraser

Catch Areas

	Statistical Area
North	- 1-12,30
Inside	- 13-20,28
West Coast	- 21-27
Fraser River	- 29

IV. Results And Discussion

A. Juvenile Chinook And Coho Releases At B.C. Hatcheries

Over 63 million chinook juveniles were released from B.C. hatcheries in 1989 (1988 brood) (Figure 1, Table 2). Further increases in releases are expected during the next few years. This growth reflects some hatcheries reaching design capacity as more brood stock becomes available, as well as expansion of incubation and rearing capacity at several sites, especially in the lower Georgia Strait.

For the 1988 brood year, 86% of the chinook released were smolts, while the remaining 14% were fed or unfed fry, considered unlikely to migrate to sea until they rear naturally in fresh water for some period of time. This natural rearing period is almost a year for some stocks, especially many of the upper Fraser River hatchery releases (Rosberg and Millar, 1987; Fraser et al., 1982). Most chinook releases were from hatcheries in the Inside production area (27.4 million), followed by the West Coast (21.1 million), the Fraser River (8.6 million) and the North (6.4 million) (Table 2).

Coho smolt production has averaged 10 million fish since the 1985 brood year, (Figure 1, Table 3), down from the 1983 brood year peak of 13.7 million, and is not expected to change markedly in the near future. Fed plus unfed fry releases have ranged from 7.3 to 13.2 million since 1980, reflecting brood stock and egg availability for many of the smaller enhancement projects in the province and deliberate reductions in numbers of fry stocked into specific watersheds. Unfed fry releases have comprised as much as 1.9 million (1984 brood) of this total.

B. Contribution Of B.C. Hatchery Chinook To Canadian Commercial And Georgia Strait Sport Fisheries

The Canadian commercial and Georgia Strait sport catch of B.C. hatchery chinook salmon averaged approximately 110,000 fish during 1978 to 1981; approximately 140,000 from 1982 to 1984; approximately 87,000 for the 1985 through 1988 period and 145,000 in 1989 (Figure 2, Table 4). In spite of the high 1989 catch of hatchery chinook, the decline during the 1985-88 period, especially during an era when increasing releases were expected to increase catch contribution, is a major concern. It is discussed further in the section on survival of hatchery chinook and coho smolts.

For 1989, contribution of fish associated with a coded-wire tag release group accounted for 84% of the estimated catch of hatchery chinook (Table 4). The remaining 16%, or 23,500 fish, was calculated for hatchery releases not associated with a coded-wire tag release group using methodology described in Appendix C. It is notable that the enhanced component of the West Coast net fishery in 1989 was estimated to be 102%. While hatchery fish are known to be a major contributor to this fishery, this inconsistency demonstrates

Fig 1: SEP chinook and coho releases by brood year and release stage.

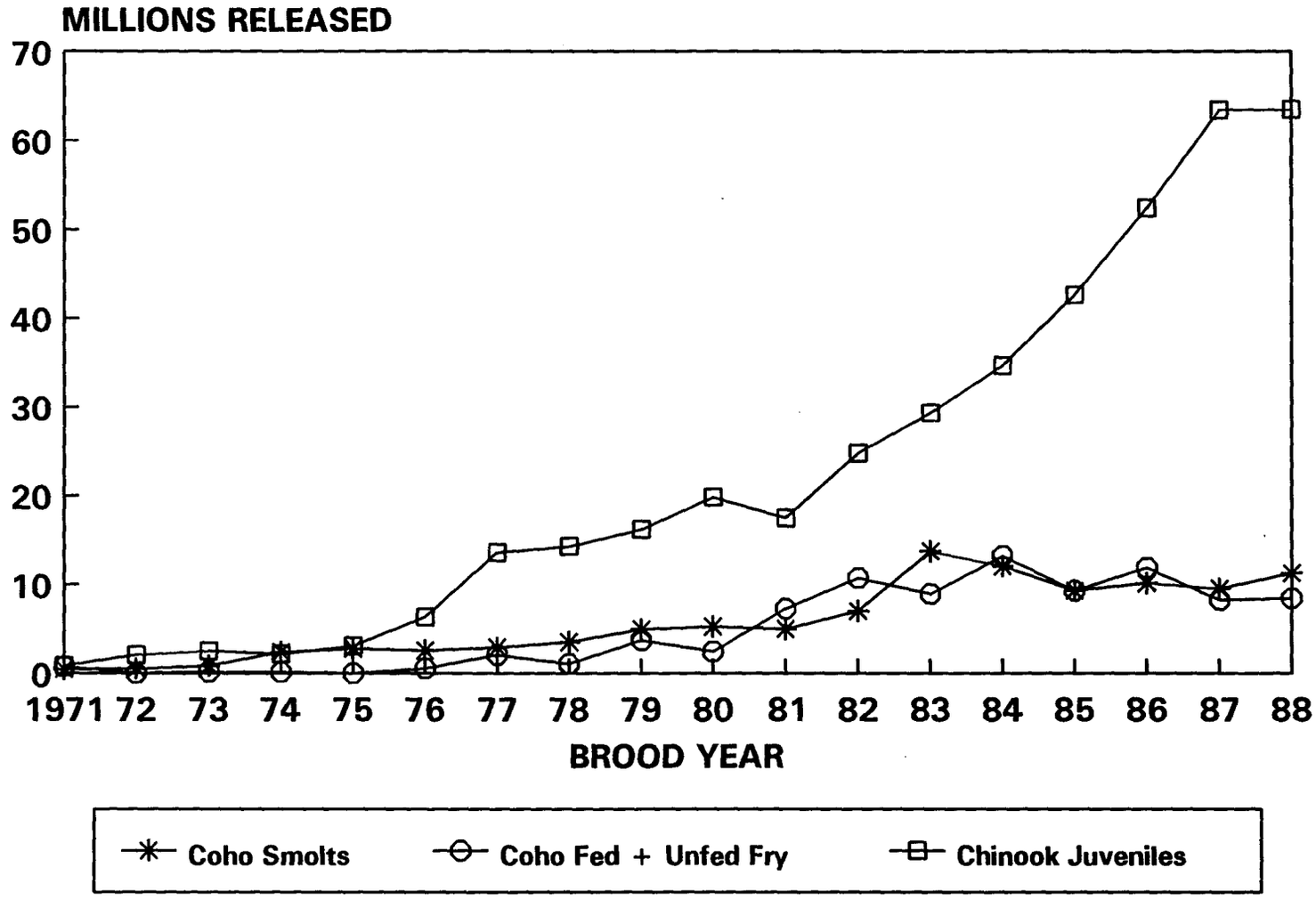


Table 2. Releases of chinook juveniles from SEP facilities by stage at release and production region for brood years 1971 to 1988.

PRODUCTION REGION	STAGE AT RELEASE	BROOD YEAR																	
		1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
NORTH	unfed fry	0	0	0	0	0	0	0	120000	300	930	54700	0	0	0	0	0	0	0
	fed fry	0	0	18609	0	52941	187008	173900	156831	86120	389350	445652	737997	816686	1407207	2785272	1548597	448637	1768498
	smolts	0	0	0	0	0	1216	76722	151771	51292	60945	191243	341919	1322106	2186954	1835791	4337824	5928566	4629320
	TOTAL	0	0	18609	0	52941	188224	250622	428602	137712	451225	691595	1079916	2138792	3594161	4621063	5886421	6377203	6397818
INSIDE	unfed fry	0	0	0	0	0	0	0	0	310160	0	0	0	222	0	224850	0	0	381749
	fed fry	169019	0	40049	39848	0	0	0	726	70046	257855	270027	436942	263860	568620	463906	757716	2124765	993173
	smolts	695138	883815	771016	393087	2051374	2466174	5329193	4661154	7785011	9423722	7523551	9607293	11856853	13152139	18456470	21449707	25795183	26019278
	TOTAL	864157	883815	811065	432935	2051374	2466174	5329193	4661880	8165217	9681577	7793578	10044235	12120935	13720759	19145226	22207423	27919948	27394200
WEST	unfed fry	0	0	0	0	0	0	0	372764	0	0	3400	0	0	0	0	0	0	0
COAST	fed fry	0	29117	23044	228940	0	0	255513	2136099	514832	232267	377565	228153	106182	102810	497562	217960	2711325	4948624
	smolts	0	1164515	1665187	1504728	960959	3693613	7731538	6641096	7306091	9248891	8350613	11654133	13088259	13090540	13917336	16331810	17275470	16132635
	TOTAL	0	1193632	1688231	1733668	960959	3693613	7987051	9149959	7820923	9481158	8731578	11882286	13194441	13193350	14414898	16549770	19986795	21081259
UPPER	unfed fry	0	0	0	0	0	0	0	0	0	0	2500	45000	0	0	0	100000	0	172000
FRASER/	fed fry	0	0	0	0	0	0	16319	12963	34111	158857	198631	1470250	230091	915255	901782	506781	464126	562726
THOMPSON	smolts	0	0	0	0	0	0	0	0	14417	17753	56083	285620	1644009	3233352	3555108	7149248	8693598	7882955
	TOTAL	0	0	0	0	0	0	16319	12963	48528	176610	257214	1800870	1874100	4148607	4456890	7756029	9157724	8617681
TOTAL	unfed fry	0	0	0	0	0	0	0	492764	310460	930	60600	45000	222	0	224850	100000	0	553749
	fed fry	169019	29117	81702	268788	52941	187008	445732	2306619	705109	1038329	1291875	2873342	1416819	2993892	4648522	3031054	5748853	8273021
	smolts	695138	2048330	2436203	1897815	3012333	6161003	13137453	11454021	15156811	18751311	16121490	21888965	27911227	31662985	37764705	49268589	57692817	54664188
	TOTAL	864157	2077447	2517905	2166603	3065274	6348011	13583185	14253404	16172380	19790570	17473965	24807307	29328268	34656877	42638077	52399643	63441670	63490958

Table 3. Releases of coho juveniles from SEP facilities by stage at release and production region for brood years 1971 to 1988.

PRODUCTION REGION	STAGE AT RELEASE	BROOD YEAR																	
		1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
NORTH	unfed fry	0	0	0	0	0	0	20000	20000	30000	33015	117550	127690	166536	73220	147114	282300	109700	135100
	fed fry	0	0	0	0	0	0	0	18817	36000	114216	498931	1053827	1052747	1001987	1248357	1668370	1394434	1091600
	smolts	0	0	0	0	0	0	0	0	0	10186	0	0	693628	933150	791253	944778	1348482	1711144
	TOTAL	0	0	0	0	0	0	20000	38817	66000	157417	616481	1181517	1912911	2008357	2186724	2895448	2852616	2937844
INSIDE	unfed fry	785855	0	0	136835	0	388316	317891	354609	352805	780210	246330	1021254	305086	1704316	165825	347830	27000	338772
	fed fry	0	0	0	0	0	136200	953934	428513	2489358	1193706	5451375	5649032	5053693	6718173	5160722	4857386	3613376	3949050
	smolts	467852	445645	762572	2112323	1974742	2081087	2521296	3027838	3823466	4252225	3940005	5620526	11274787	9448000	7134572	7646065	7206048	7759779
	TOTAL	1253707	445645	762572	2249158	1974742	2605603	3793121	3810960	6665629	6226141	9637710	12290812	16633566	17870489	12461119	12851281	10846424	12047601
WEST	unfed fry	0	0	160578	0	0	0	0	113000	292500	188986	138368	239800	106200	95057	115300	98073	81514	142860
COAST	fed fry	0	0	0	0	0	0	781994	122196	514845	121605	799263	2519065	1450404	2033048	1072503	2413184	1483907	1358538
	smolts	0	44536	92824	253707	794227	469997	387536	485213	1117774	991262	1029084	1375329	1729638	1647309	1224066	1451971	792644	1525840
	TOTAL	0	44536	253402	253707	794227	469997	1169530	720409	1925119	1301853	1966715	4134194	3286242	3775414	2411869	3963228	2358065	3027238
UPPER	unfed fry	0	0	0	0	0	0	0	0	450	13800	7600	12850	34130	0	442	240	38000	21000
FRASER/	fed fry	0	0	0	0	0	0	0	0	0	10500	12000	104065	772355	1574563	1376926	2222415	1505649	1420579
THOMPSON	smolts	0	0	0	0	0	0	0	0	0	0	0	0	27700	27114	137875	110610	193871	266694
	TOTAL	0	0	0	0	0	0	0	0	450	24300	19600	116915	834185	1601677	1515243	2333265	1737520	1708273
TOTAL	unfed fry	785855	0	160578	136835	0	388316	337891	487609	675755	1016011	509848	1401594	611952	1872593	428681	728443	256214	637732
	fed fry	0	0	0	0	0	136200	1735928	569526	3040203	1440027	6761569	9325989	8329199	11327771	8858508	11161355	7997366	7819767
	smolts	467852	490181	855396	2366030	2768969	2551084	2908832	3513051	4941240	5253673	4969089	6995855	13725753	12055573	9287766	10153424	9541045	11263457
	TOTAL	1253707	490181	1015974	2502865	2768969	3075600	4982651	4570186	8657198	7709711	12240506	17723438	22666904	25255937	18574955	22043222	17794625	19720956

Fig 2: Contribution of B.C. hatchery chinook salmon to Canadian commercial and Georgia Strait sport fisheries.

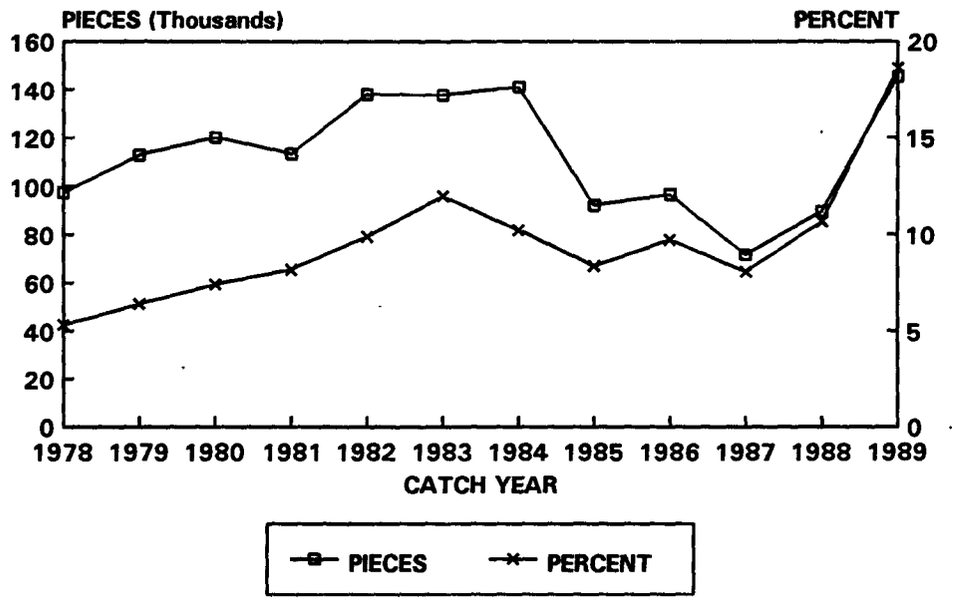


Fig 3: Contribution of B.C. hatchery coho salmon to Canadian commercial and Georgia Strait sport fisheries.

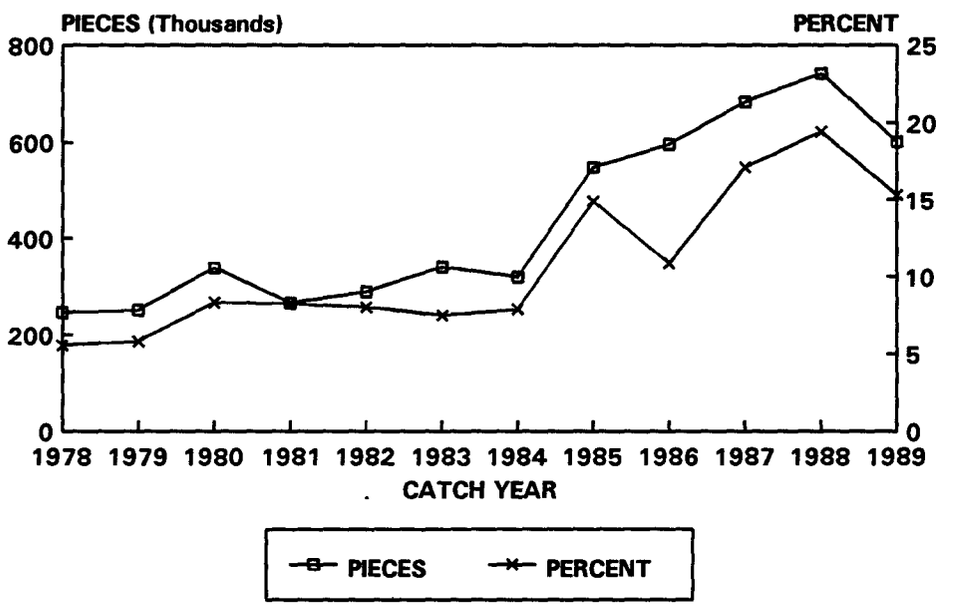


Table 4. B.C. hatchery chinook contribution (in pieces and percent) to Canadian commercial and Georgia Strait sport catch by fishery and recovery year.

FISHERY	RECOVERY YEAR											
	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
Northern Troll	245863	257757	261451	231401	248877	268626	262966	215542	205554	241472	183471	226618
SEP Associated Contribution	19413	33019	30418	28798	38707	38101	30186	22252	16844	15626	16078	28047
SEP Unassociated Contribution	127	97	522	2842	4651	2683	796	863	1187	2871	4073	5402
Total	19540	33116	30940	31640	43358	40784	30982	23115	18031	18497	20151	33449
% SEP Contribution	7.95	12.85	11.83	13.67	17.42	15.18	11.78	10.72	8.77	7.66	10.98	14.76
West Coast Troll	555256	480377	488155	397520	543783	385369	460056	354067	342063	378930	408723	203462
SEP Associated Contribution	6901	10115	16059	6460	10844	8344	18677	10513	9635	7849	12034	9962
SEP Unassociated Contribution	45	30	276	637	1303	588	493	408	679	1442	3049	1918
Total	6946	10145	16335	7097	12147	8932	19170	10921	10314	9291	15083	11880
% SEP Contribution	1.25	2.11	3.35	1.79	2.23	2.32	4.17	3.08	3.02	2.45	3.69	5.84
Inside Troll	216356	257672	273591	239494	178707	105264	88432	55735	44223	38723	19624	28525
SEP Associated Contribution	11991	21042	13079	7552	9542	10215	10165	3568	6813	5702	3112	1574
SEP Unassociated Contribution	78	62	225	745	1147	719	268	138	480	1048	788	303
Total	12069	21104	13304	8297	10689	10934	10433	3706	7293	6750	3900	1877
% SEP Contribution	5.58	8.19	4.86	3.46	5.98	10.39	11.80	6.65	16.49	17.43	19.88	6.58
Northern Net	117969	141402	90541	91392	133399	60228	61114	98569	98969	63790	62323	58533
SEP Associated Contribution	5206	13703	12172	9110	14483	9766	8732	11033	17273	8678	9719	7651
SEP Unassociated Contribution	34	40	209	899	1740	688	230	428	1217	1595	2462	1473
Total	5240	13743	12381	10009	16223	10454	8962	11461	18490	10273	12181	9124
% SEP Contribution	4.44	9.72	13.67	10.95	12.16	17.36	14.67	11.63	18.68	16.10	19.55	15.59
West Coast Net	49791	60356	59045	72886	45108	41818	50771	22001	5902	628	16548	40395
SEP Associated Contribution	4551	304	15465	12533	19902	21105	20055	1595	202	19	8144	34383
SEP Unassociated Contribution	30	1	266	1237	2391	1486	529	62	14	3	2063	6622
Total	4581	305	15731	13770	22293	22591	20584	1657	216	22	10207	41005
% SEP Contribution	9.20	.51	26.64	18.89	49.42	54.02	40.54	7.53	3.66	3.58	61.68	101.51
Inside Net	164433	130136	96086	100662	83168	88681	86654	123839	115701	43297	30903	91397
SEP Associated Contribution	15459	9010	6530	7107	11463	13178	8959	11396	9686	4319	3797	13823
SEP Unassociated Contribution	101	26	112	701	1377	928	236	442	683	794	962	2662
Total	15560	9036	6642	7808	12840	14106	9195	11838	10369	5113	4759	16485
% SEP Contribution	9.46	6.94	6.91	7.76	15.44	15.91	10.61	9.56	8.96	11.81	15.40	18.04
Georgia Strait Sport	486000	440000	355000	253000	164000	198000	369445	234838	181895	121081	119117	132846
SEP Associated Contribution	33151	25216	24284	31575	18253	27823	40617	28304	29769	18255	18625	26445
SEP Unassociated Contribution	217	74	417	3116	2193	1959	1072	1098	2098	3355	4718	5093
Total	33368	25290	24701	34691	20446	29782	41689	29402	31867	21610	23343	31538
% SEP Contribution	6.87	5.75	6.96	13.71	12.47	15.04	11.28	12.52	17.52	17.85	19.60	23.74
TOTAL												
COMMERCIAL + GEORGIA ST. SPORT	1835668	1767700	1623869	1386355	1397042	1147986	1379438	1104591	994307	887921	840709	781776
SEP Associated Contribution	96672	112409	118007	103135	123194	128532	137391	88661	90222	60448	71509	121885
SEP Unassociated Contribution	632	330	2027	10177	14803	9050	3625	3438	6358	11108	18115	23478
Total	97304	112739	120034	113312	137997	137582	141016	92099	96580	71556	89624	145358
% SEP Contribution	5.30	6.38	7.39	8.17	9.88	11.98	10.22	8.34	9.71	8.06	10.66	18.59

the potential for error in estimating the contribution of CWT associated and unassociated chinook and coho. Contribution of unassociated releases averaged 17.3% for 1987-89 and 4.2% for 1984-86.

The proportion of the Canadian commercial and Georgia Strait sport catch comprised of B.C. hatchery chinook peaked in 1983 at 11.98%, declined erratically to a low of 8.06% in 1987 and recovered to 18.6% in 1989 (Figure 2). The Georgia Strait sport fishery has been the single largest harvester of enhanced chinook since 1984, with an average catch of nearly 27,500 B.C. hatchery fish for the 1985-89 period (Table 4). The North, West Coast and Inside troll fisheries averaged 22,600, 11,500 and 4,700 B.C. hatchery chinook respectively for the same time period while net fisheries in the North, West Coast and Inside catch areas took 12,300, 10,600, and 9,700 hatchery chinook respectively. The average percent contribution of B.C. hatchery chinook for 1985-89 was highest in the West Coast net, Georgia Strait sport, and Northern net fisheries (35.6%, 18.2%, and 16.3% of the total catch respectively), intermediate in the Inside troll, Inside net, and Northern troll fisheries (13.4%, 12.8% and 10.6%), and lowest in the West Coast troll fishery (3.6%). In years of high abundance there is a directed net fishery in Barkley Sound on Robertson Creek chinook. This accounts for the widely fluctuating catch and the high average Canadian hatchery contribution to the West Coast Net fishery.

C. Contribution Of B.C. Hatchery Coho To Canadian Commercial and Georgia Strait Sport Fisheries

B.C. hatchery coho made a steadily increasing contribution to Canadian commercial and Georgia Strait sport fisheries from 1985 to 1988 before which catches hovered around 300,000 (Figure 3). The estimated catch of nearly 742,000 enhanced coho in 1988 accounted for 19.4% of all catches in B.C. commercial and Georgia Strait fisheries. The 1989 catch numbered 600,000 pieces (Table 5).

In 1989, 72% of the enhanced catch was comprised of fish directly associated with a coded-wire tag release group (Table 5). The remaining 28%, or 167,000 fish, were unassociated hatchery fish calculated as described in Appendix C. The average contribution of unassociated releases for 1985-89 was 19.0%

Most of the dramatic increase in the catch of B.C. hatchery coho in recent years has been in the Georgia Strait sport and Inside troll fisheries. Combined catch for these two fisheries has averaged 364,000 hatchery coho from 1985-89 (Table 5). For the same time period, hatcheries contributed an average of 40.6% of the Georgia Strait sport and 44.3% of the Inside troll catches.

The West Coast troll fishery peaked at some 209,000 B.C. hatchery coho in 1989, the highest recorded to date. The northern troll catch of B.C. hatchery coho reached 81,000 in 1986, about 5% of the fishery total but had declined to some 21,000 by 1989. The

Table 5. B.C. hatchery coho contribution (in pieces and percent) to Canadian commercial and Georgia Strait sport catch by fishery and recovery year.

FISHERY	RECOVERY YEAR											
	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
Northern Troll	880978	767218	860837	657206	604098	1230418	892155	662999	1682864	810226	531893	696992
SEP Associated Contribution	25543	11451	27197	33633	17719	65099	28415	16457	72038	34707	25295	14810
SEP Unassociated Contribution	488	478	2051	1544	3430	6200	6786	4188	9342	6522	5558	5725
Total	26031	11929	29248	35177	21149	71299	35201	20645	81380	41229	30853	20535
% SEP Contribution	2.95	1.55	3.40	5.35	3.50	5.79	3.95	3.11	4.84	5.09	5.80	2.95
West Coast Troll	1360271	1912878	1738472	1385324	1777434	2167435	2172164	1389056	2156833	1821021	1595800	1952998
SEP Associated Contribution	41321	41335	44737	46043	52247	69185	100188	78981	143291	140256	96137	150695
SEP Unassociated Contribution	789	1726	3373	2114	10114	6589	23926	20099	18583	26357	21126	58262
Total	42110	43061	48110	48157	62361	75774	124114	99080	161874	166613	117263	208957
% SEP Contribution	3.10	2.25	2.77	3.48	3.51	3.50	5.71	7.13	7.51	9.15	7.35	10.70
Inside Troll	328204	225737	153019	69134	117285	57941	84057	191516	184314	217727	256668	73436
SEP Associated Contribution	35588	26474	26978	12937	22345	6701	14172	48772	64257	96495	93137	28225
SEP Unassociated Contribution	679	1105	2034	594	4326	638	3384	12411	8333	18134	20466	10912
Total	36267	27579	29012	13531	26671	7339	17556	61183	72590	114629	113603	39137
% SEP Contribution	11.05	12.22	18.96	19.57	22.74	12.67	20.89	31.95	39.38	52.65	44.26	53.29
Northern Net	377632	285045	282937	201038	302831	374126	224533	274938	493731	196425	171181	202460
SEP Associated Contribution	2906	2791	2856	995	1641	2434	444	1672	6593	3100	4156	3732
SEP Unassociated Contribution	55	117	215	46	318	232	106	425	855	583	913	1442
Total	2961	2908	3071	1041	1959	2666	550	2097	7448	3683	5069	5174
% SEP Contribution	.78	1.02	1.09	.52	.65	.71	.24	.76	1.51	1.87	2.96	2.56
West Coast Net	29333	25378	15170	7392	13400	9208	10559	7515	10581	7242	10968	39648
SEP Associated Contribution	3500	46	879	469	245	621	2045	659	1138	467	1293	5304
SEP Unassociated Contribution	67	2	66	22	47	59	488	168	148	88	284	2050
Total	3567	48	945	491	292	680	2533	827	1286	555	1577	7354
% SEP Contribution	12.16	.19	6.23	6.64	2.18	7.39	23.99	11.00	12.15	7.66	14.38	18.55
Inside Net	357218	397021	363973	494883	345403	283798	215679	420422	374587	294889	169756	464895
SEP Associated Contribution	39859	20217	47412	66543	58757	82953	37568	80001	61054	42891	41224	68408
SEP Unassociated Contribution	761	844	3575	3055	11374	7901	8972	20358	7918	8060	9059	26448
Total	40620	21061	50987	69598	70131	90854	46540	100359	68972	50951	50283	94856
% SEP Contribution	11.37	5.30	14.01	14.06	20.30	32.01	21.58	23.87	18.41	17.28	29.62	20.40
Georgia Strait Sport	1103000	708735	642000	391200	436090	404026	443590	728197	571980	641572	1084790	497223
SEP Associated Contribution	92547	138333	164441	93269	89073	83133	74514	209811	178855	257113	346954	161488
SEP Unassociated Contribution	1767	5775	12399	4282	17243	7918	17795	53391	23195	48318	76241	62435
Total	94314	144108	176840	97551	106316	91051	92309	263202	202050	305431	423195	223923
% SEP Contribution	8.55	20.33	27.55	24.94	24.38	22.54	20.81	36.14	35.32	47.61	39.01	45.03
TOTAL												
COMMERCIAL + GEORGIA ST. SPORT	4436636	4322012	4056408	3206177	3596541	4526952	4042737	3674643	5474890	3989102	3821056	3927652
SEP Associated Contribution	241264	240647	314500	253889	242027	310126	257346	436353	527226	575029	608196	432662
SEP Unassociated Contribution	4606	10047	23713	11657	46852	29537	61458	111040	68375	108061	133647	167278
Total	245870	250694	338213	265546	288879	339663	318804	547393	595601	683090	741843	599936
% SEP Contribution	5.54	5.80	8.34	8.28	8.03	7.50	7.89	14.90	10.88	17.12	19.41	15.27

catch of enhanced coho in this fishery probably fluctuates as a function of survival rate and migratory behaviour of southern stocks. As well, catches in the West Coast troll have been limited by catch ceilings in some years.

For the 1985-89 period, net gear harvested an average of about 5,000 hatchery coho in the Northern area and about 73,000 in the Inside area.

D. Contribution of B.C. Hatchery Chinook and Coho to U.S. Fisheries and Other B.C. Sport Fisheries

B.C. hatcheries contribute significantly to Washington and Alaska fisheries. In 1989, Canadian hatchery contribution of chinook to Alaska was estimated at 55,000 pieces (Table 6) while contribution to Washington fisheries numbered some 3,800 (Table 7). Average chinook contribution to Alaska for 1985-89 was 33,500 and average contribution to Washington was nearly 5,000. B.C. hatchery coho contribution to Washington in 1989 was nearly 40,000 fish with 5,800 taken in Alaska. Coho contribution to U.S. fisheries peaked in 1986 at 11,000 and 38,000 to Alaska and Washington respectively.

B.C. hatchery contribution to all B.C. sport fisheries is also shown in Tables 6 and 7; commercial and Georgia Strait sport catch have been included for completeness. Catch of B.C. hatchery chinook in sport fisheries other than Georgia Strait accounted for nearly 28,000 pieces in 1989 or 51% of the total sport catch and an average of 13,000 for the 1985-89 period. For B.C. hatchery coho, about 15,000 (8.4% of the total sport catch) were taken in sport fisheries outside Georgia Strait in 1989 and an average of 14,000 for 1985-1989.

Percent contribution to U.S. and other sport fisheries were not calculated as total catch data were unavailable.

E. Survival Of B.C. Hatchery Chinook And Coho Smolts

Survival analyses were done for coded wire-tagged releases, excluding purely experimental releases. All survival values are underestimates due to data quality problems described in Section III.

Survival data for chinook and coho smolts released from individual hatcheries and the average survival for each production area, weighted by the number of CWT's released per hatchery, are summarized for the 1975 to 1985 brood years in Tables 8 and 9. Survival of B.C. hatchery chinook smolts fell to low levels for their 1977 brood and has not recovered (Figure 4). Declines in coho smolt survival occurred for the 1978 brood year and have averaged less than 10% since the 1979 brood year with a significant recovery

Table 6. B.C. hatchery chinook contribution (in pieces) to Canadian and U.S. fisheries by recovery year.

	Recovery Year											
	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
Commercial												
Troll	38305	64177	59556	42811	59093	56659	59028	36333	33292	30603	31223	39582
Net	25216	23017	34166	28750	45849	44048	37746	24025	27160	13778	21987	55857
Total	63521	87194	93722	71561	104942	100707	96774	60358	60452	44381	53210	95439
Sport												
Georgia Strait	33151	25216	24284	31575	18253	27823	40617	28304	29769	18255	18801	26445
Central	348	292	1640	865	1178	2435	1997	1204	1792	2873	2592	3306
North	0	225	47	35	80	295	155	225	562	275	1309	2214
West Coast Van.Is.	5446	5125	4439	4936	9154	4901	11041	5380	3438	6208	7328	17334
Freshwater	0	0	0	183	15	1139	1013	949	608	1050	2177	5028
Total	38945	30858	30410	37594	28680	36593	54823	36062	36169	28661	32207	54327
Total Canadian	102466	118052	124132	109155	133622	137300	151597	96420	96621	73042	85417	149766
U.S.												
Washington	N.A.*	N.A.	N.A.	N.A.	N.A.	N.A.	2840	7005	4551	4627	4451	3767
Alaska	N.A.	N.A.	61944	33880	47861	53428	42817	29047	19239	24219	40319	54681
Total U.S.	N.A.	N.A.	61944	33880	47861	53428	45657	36052	23790	28846	44770	58448
Total U.S. + Canada	102466	118052	248020	176915	229344	244156	242911	168524	144201	130734	174957	266662
% Caught in Canadian Fisheries	N.A.	N.A.	50.05	61.70	58.26	56.23	62.41	57.21	67.00	55.87	48.82	56.16

*N.A. - Data not available; contribution unknown

Table 7. B.C. hatchery coho contribution (in pieces) to Canadian and U.S. fisheries by recovery year.

	Recovery Year											
	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
Commercial												
Troll	41502	79259	98913	92614	92351	140986	142773	144211	279856	274882	214569	193731
Net	49290	23054	51147	68007	60656	86007	40057	82331	68784	48523	46667	77444
Total	90792	102313	150060	160621	153007	226993	182830	226542	348640	323405	261236	271175
Sport												
Georgia Strait	92547	138333	164441	93269	89098	83136	74514	209811	178855	257113	347100	161488
Central	283	615	933	1191	2263	2337	2410	2338	2971	2066	2886	1934
North	0	0	0	0	0	76	199	246	63	862	3618	917
West Coast Van.Is.	282	317	110	202	401	814	347	602	1880	3683	951	2322
Freshwater	0	0	0	66	195	2400	3114	4671	11044	10350	7991	9648
Total	93112	139265	165484	94728	91957	88763	80584	217668	194813	274074	362546	176309
Total Canadian	183904	241578	315544	255349	244964	315756	263414	444210	543453	597479	623782	447484
U.S.												
Washington	N.A.*	N.A.	N.A.	N.A.	N.A.	N.A.	7019	27741	38052	28147	23399	39470
Alaska	N.A.	N.A.	711	225	470	950	1226	242	11081	4024	2286	5797
Total U.S.	N.A.	N.A.	711	225	470	950	8245	27983	49133	32171	25685	45267
Total U.S. + Canada	183904	241578	316255	255574	245434	316706	271659	472193	592586	629650	649467	492751
% Caught in Canadian Fisheries	N.A.	N.A.	99.78	99.91	99.81	99.70	96.96	94.07	91.71	94.89	96.05	90.81

*N.A. - Data not available; contribution unknown

Table 8. Weighted average survival (%) of chinook smolts by hatchery and brood year.

	BROOD YEAR										
	75	76	77	78	79	80	81	82	83	84	85
NORTH											
Atnarko River	.7	.2	.3	.6							
Fulton River	.0	.1	.1	.2	.5						
Kalum						.4	.2	.0			
Kispiox River						.1	.0			.1	
Kitimat River			.9	1.2	1.7	1.7	1.2	.9	.4	1.6	.3
Masset					.2	.5	.1	.1	.2	.0	
Snootli Creek							.6	.1	.2	.3	.1
Terrace						.0	.0		.1	.2	.0
Whitehorse										.0	.1
WEIGHTED AVERAGE	.1	.1	.5	.8	.8	.6	.5	.2	.3	1.0	.2
INSIDE											
Big Qualicum River	3.5	8.6	1.7	.8	.4	.3	.9	1.1	.9	.1	.1
Capilano River	1.9	4.0	1.2	1.5	.8	1.7	1.7	.2	.3	.1	.0
Chehalis R CPD						.0	7.3				
Chehalis River								1.1	.2	.2	.3
Chemainus River					8.3	3.0		4.6	1.2	5.0	2.0
Chilliwack River							6.8	1.4	2.3	3.1	.2
Cowichan River					4.5	1.8	1.8	2.3	2.0		.8
Devereux Creek										.0	.0
Indian River					.4						
Little Qualicum R					1.1	.5	1.3	2.4	1.0	.3	.2
Nanaimo River					3.7	7.4		.4	.4		
Nimpkish									.3	.5	
Puntledge River	1.7	5.2	.9	.9	.4	.8	.5	.2	.3	.2	.1
Quinsam River	.5	2.6	.9	1.5	.8	.9	2.3	1.3	1.0	1.5	.2
Sechelt									.3		
Seymour River					.1					.0	
Stave Lake									.0		
Tenderfoot Creek							.6	.4	.8	.3	.1
WEIGHTED AVERAGE	2.2	5.3	1.4	1.0	.8	.8	1.6	1.2	.8	.7	.2
WEST COAST											
Conuma River					1.5	.5	1.0	.4	.1	.2	.5
Gold River											.2
Marble River								.5	.4	1.0	.3
Nitinat River						.6	.4	.5	.5	.6	.5
Robertson Creek	2.5	4.2	1.3	2.4	2.0	1.2	.8	.4	.0	1.2	.8
San Juan River					.7		.0	.5			
Sooke River							1.0				
Tahsis											.1
Thornton Cr								1.9	1.1		
WEIGHTED AVERAGE	2.5	4.2	1.3	2.4	2.0	1.2	.7	.4	.1	.9	.7
UPPER FRASER											
Birkenhead River			.3	.2	.1	.0	.1	.0	.0	.0	.0
Clearwater R										.1	.2
Eagle River									.3	.2	.1
Fort St James									.3	.2	
Loon Creek						.1	.1	.2	.1	.1	.3
Penny						.0	.0	.0			
Penny CDP										.0	
Quesnel River									.1	.0	.0
Shuswap River										.9	.4
Spius Creek										.1	.1
Stuart River								.2			
WEIGHTED AVERAGE	.0	.0	.3	.2	.1	.0	.1	.0	.1	.1	.1
OVERALL											
WEIGHTED AVERAGE	2.3	4.5	1.3	1.8	1.4	1.0	1.1	.7	.4	.8	.3

Note: Survivals are absolute minimum estimates because of the reasons noted in Section III, particularly the non-inclusion of naturally spawning hatchery fish. Also, survival for the 1985 brood is incomplete.

Table 9. Weighted average survival (%) of coho smolts by hatchery and brood year.

	BROOD YEAR										
	75	76	77	78	79	80	81	82	83	84	85
NORTH											
Fort Babine										2.0	.8
Kincolith										2.6	.2
Kispiox River										2.5	.4
Kitimat River									4.5	1.7	.9
Masset						2.7					
Oldfield Creek											.3
Toboggan Cr											.6
WEIGHTED AVERAGE						2.7			4.5	1.9	.8
INSIDE											
Alouette River								11.7			
Big Qualicum River	20.3	21.6	28.9	12.9	11.4	11.4	9.4	5.5	1.1	.9	2.4
Brunette River							1.3				
Capilano River	20.5	12.7	12.1	15.9	8.6	9.9	9.5	10.6	4.3	10.2	16.6
Chehalis River								12.1	11.4	12.7	15.1
Chilliwack River						11.8	10.4	15.7	10.2	15.7	19.7
Inch Creek								7.3	6.2	8.1	15.7
Indian Arm				8.4	4.2						
Kanaka Creek										10.9	
L.Campbell River									11.1		
Noons Creek							4.8				
Puntledge River		28.9	14.4	13.6	9.6	8.9	7.2	15.0	10.0	3.6	4.2
Quinsam River	12.3	8.0	10.2	8.0	5.9	6.3	5.4	7.9	7.7	9.7	10.4
Rosewall Creek											8.6
Sechelt				5.8	3.9	6.4	8.8	6.8			
Seymour River				10.2	5.2	6.4		5.5			
Sliammon River					12.8			6.7			
Tenderfoot Creek								11.2	9.3	10.9	14.8
WEIGHTED AVERAGE	17.5	16.1	15.2	11.2	9.2	9.0	8.3	10.5	6.1	7.5	12.1
WEST COAST VAN. ISL.											
Conuma River									14.8	6.7	4.8
Robertson Creek	8.0	9.8	5.5	2.8	2.2	5.6	6.9	2.1	4.2	3.0	1.8
Thornton Cr								6.1			
WEIGHTED AVERAGE	8.0	9.8	5.5	2.8	2.2	5.6	6.9	2.2	4.6	3.3	2.1
UPPER FRASER											
Birkenhead River									4.0		
Eagle River										3.2	4.3
Spius Creek											5.1
WEIGHTED AVERAGE									4.0	3.2	4.9
OVERALL WEIGHTED AVERAGE	14.7	14.7	13.9	9.9	7.4	8.3	8.0	8.7	5.8	6.6	9.5

Note: Survivals are absolute minimum estimates because of the reasons noted in Section III, particularly the non-inclusion of naturally spawning hatchery fish.

Fig 4: Survival to adult for B.C. hatchery chinook smolts (mean and range).

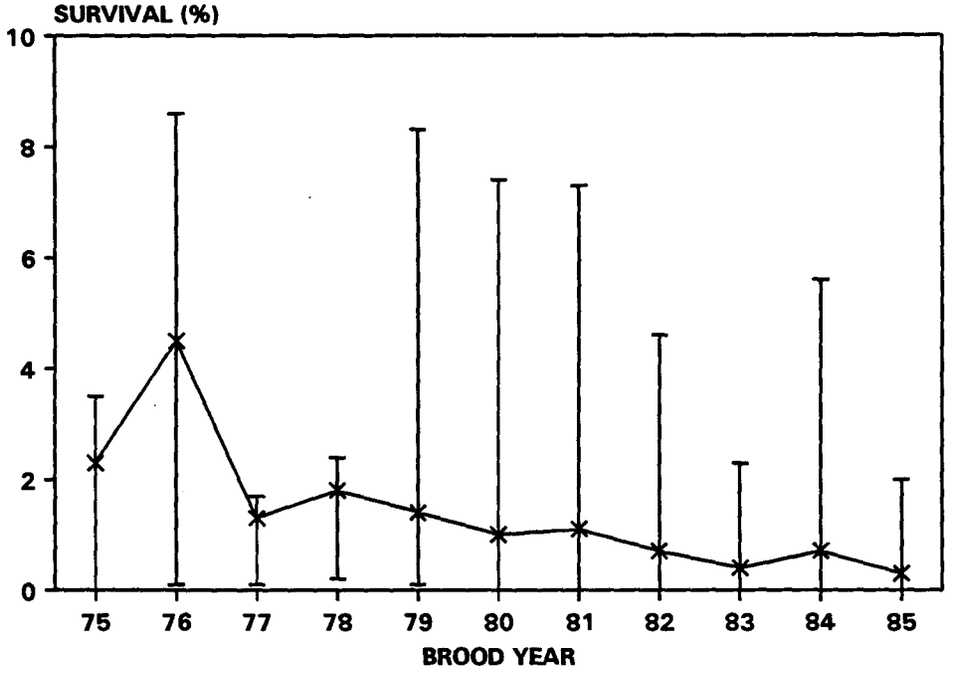
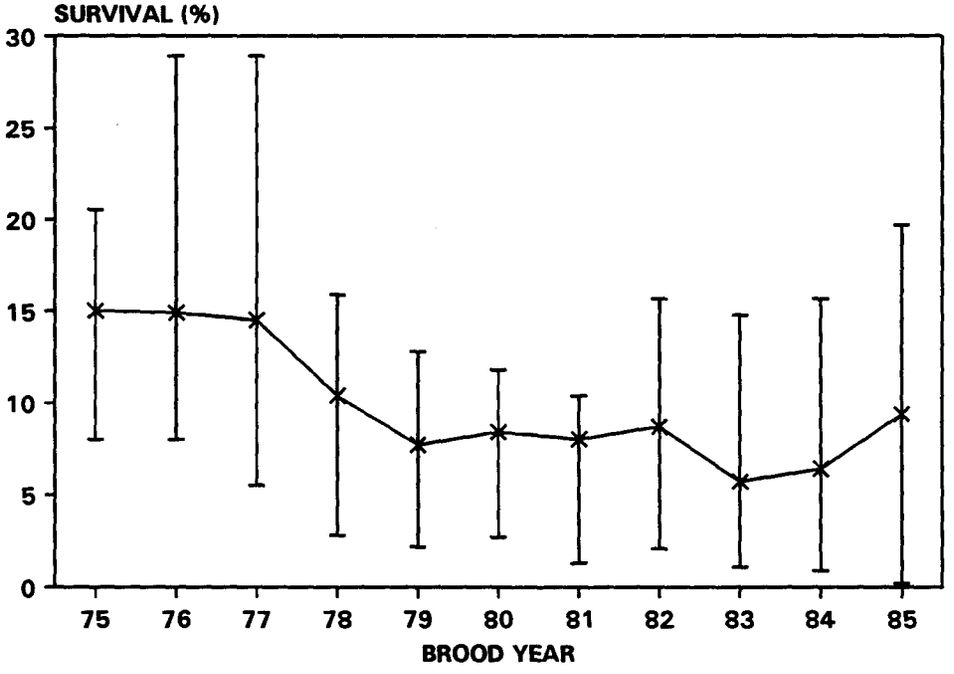


Fig 5: Survival to adult for B.C. hatchery coho smolts (mean and range).



for the 1985 brood (Figure 5). These trends are virtually identical to those for average Inside hatchery stocks (Table 9) since the Inside hatcheries dominate production in the province.

West Coast smolt survival rates, representing primarily Robertson Creek, reveal some differences compared to Inside hatcheries (Tables 8 and 9). While chinook salmon smolts often survived at rates equal to or greater than the rates for Inside chinook, coho smolt survival has been consistently lower with a maximum of 10% up to the 1976 brood year and ranging from 2% to 7% since then. Time trends for both chinook and coho also differ from the Inside stocks. Chinook survival rebounded in the 1978 brood year but has shown fairly consistent declines thereafter. Coho survival has been highly variable.

Interpretation of survival rates for North and Upper Fraser production area hatcheries (Tables 8 and 9) must be done with extreme caution since releases of chinook up to the early 1980's in both areas, and of coho to the mid 1980's in the Upper Fraser, were from small pilot studies. Because none of the larger hatcheries in these areas have attraction fishways and because of the stocks' relatively low exposure to fishing pressure, naturally spawning escapement is a large component of production and is largely unsampled. Since survival calculations do not include unsampled portions of the escapement (see Section III) survival values are minimums. This caution also applies to other stocks, for example Chehalis chinook, but has less impact because exploitation rates are higher. Available data indicate North and Upper Fraser hatchery chinook stocks are surviving at rates of less than 1% and that rates are especially low for Upper Fraser stocks. Coho survival rates are in the same range as West Coast stocks.

Several observations on trends indicate that not all chinook hatcheries demonstrate a decrease in survival over time. For example, the Chemainus hatchery chinook survival rates have exceeded expectations (Tables 1 and 8). Some Upper Fraser chinook releases are surviving at rates equal to or greater than expected (e.g. Shuswap and Eagle, unpublished data). For coho salmon, survival rates for many stocks have been fairly stable since the late 1970's with many experiencing their best return for the 1985 brood year. Big Qualicum coho raise particular concern due to poor results since the 1981 brood year. Big Qualicum hatchery coho have suffered an unexplained disease prior to release during the past several years and the smolts were known to be poorer quality fish.

A number of steps are being taken to improve survival of hatchery chinook and coho smolts. These range from reduced loading densities during the rearing phase (e.g. Big Qualicum chinook and coho), to optimization of time and size at release based on accumulated data from previous releases (all hatcheries), to rearing of small to large numbers of chinook for up to three weeks in sea pens prior to release. Time and size at release and short-term rearing in sea pens appear to have substantial impact on post-release survival (unpublished data).

There is a need to normalize survival rate estimates for chinook smolts between facilities and over time by converting all recovered fish and catch and release mortalities to adult equivalents, as is currently done for selected stocks for stock assessment purposes (Anon, 1990). Given equal recruitment to their second ocean year, hatcheries that contribute to fisheries with lower size limits will enjoy a higher apparent survival than others and increases in size limits will result in apparent declines in survival over time. In addition, the growing prevalence of chinook non-retention fisheries and increases in size limits will result in higher mortality from catching and releasing fish and lower survival estimates compared to years prior to such changes in fisheries management. Much of the success of chinook hatcheries through the mid 1970's was due to the catch of 2 and 3 year old fish, most of which could not be legally retained in today's commercial and sport fisheries. The result is that apparent survival rates seen in this early period may never be achieved again even if, biologically, the stock remains as productive.

F. Comparison Of Time Trends For Wild And Hatchery Coho Smolt Survival

A number of factors have been cited as possible explanations for reduced ocean survival of hatchery chinook and coho. The list includes poor quality hatchery fish, disease agents, predation, over-loading of available habitat and ocean conditions. There is also the affect of changing fisheries regulations which restrict catch of young fish and induce mortality through minimum size limits and non-retention fisheries. Both decrease mortality (but not catch) due to fishing and both will reduce the apparent survival of species handled. The relationship between survival and smolt release number is generally negative, suggesting a production magnitude-linked problem which might have an effect in the hatchery or after release. Relationships of this type are evident for specific hatcheries and on a B.C. coastwide basis. It should be noted, however, that production levels have increased steadily over time. Thus it is not possible to separate the effects of production level on survival from that of some other factor(s) such as ocean temperature or salinity that may also be strongly correlated with time over the same period.

Debate over the causes for changes in survival of hatchery fish usually condense to whether of not the phenomenon is unique to hatchery stocks or if similar trends apply to wild stock. A hatchery-specific phenomenon would strongly suggest fish cultural, density or related problems. A more general phenomenon affecting both wild and hatchery fish would suggest factors beyond those of hatchery practice or production levels. These hypotheses can be tested by comparing survival from tagging data for wild and comparable hatchery populations. Unfortunately there are no tagging data for wild chinook that are suitable for such analysis but there are appropriate wild coho data.

A number of wild coho smolt tagging studies were done in B.C. during the 1973 to 1985 brood years. Although no stocks were tagged annually, some Inside and Fraser River stocks were tagged in the mid-1970's and again in the 1980's (tagging locations shown in Appendix B). These data were examined for survival trends. The survival rates reported (Table 10) are to catch only to eliminate inconsistencies due to variable escapement sampling and enumeration effort.

For Inside coho, results are shown for stocks which span a wide time period (Figure 6). Survival to catch for wild coho smolts of Inside stocks has shown a consistent declining trend from the mid-1970's to the mid 1980's. For comparison, the mean survival to catch for all Inside hatchery smolt releases is also plotted in Figure 6, and these data show a similar trend with time. There was some recovery for the 1985 brood for Trent River wild coho and the Inside hatcheries but the overall trends in Georgia Strait wild coho survival to catch were inconsistent, as they were for individual hatchery stocks.

For the Lower Fraser stocks, the survival to catch of wild coho smolts from the Salmon River in the Lower Fraser and of smolts from Lower Fraser hatcheries increased sharply for 1985 brood fish compared to 1984 brood fish (Figure 7). Trends in Lower Fraser wild and hatchery coho smolt survival appear closely correlated. It was concluded that, especially for Lower Fraser stocks, trends in survival of hatchery smolts reflect trends in survival of wild smolts.

These data indicate that factors outside the hatchery, and outside the effect of hatchery production strategies, influence the productivity of both wild and hatchery coho.

Table 10. Survival (%) to catch of wild coho stocks and comparable hatchery stocks.

INSIDE STOCKS	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
Little Campbell								10.8	6.0				
Goldstream				12.9									
Cowichan/Koksilah	8.4	7.9					1.4						
Chemainus/Bonsall			18.7	18.9									
French												1.3	5.3
Little Qualicum											3.8	5.7	4.8
Trent											5.2	9.3	12.3
Black Creek				17.6	17.0						9.3	10.1	9.5
Quinsam			7.7	7.3								3.2	2.4
Keogh			4.0	8.4									
Kakweiken			6.0										
Squamish	6.6												
Inside Hatcheries *	12.8	10.6	15.4	9.5	10.4	11.5	5.3	6.2	5.8	7.2	5.7	6.5	7.0
FRASER STOCKS													
Chilliwack/Vedder		15.4	17.7	16.0				12.7					
Salmon				7.6	10.7	9.5						7.6	14.4
Fraser Hatcheries *								9.2	7.4	10.8	7.1	9.2	14.6

* Survival represents unweighted mean survival for coho releases from facilities within the production regions.

Fig 6: Survival to catch of Inside wild and hatchery coho smolts.

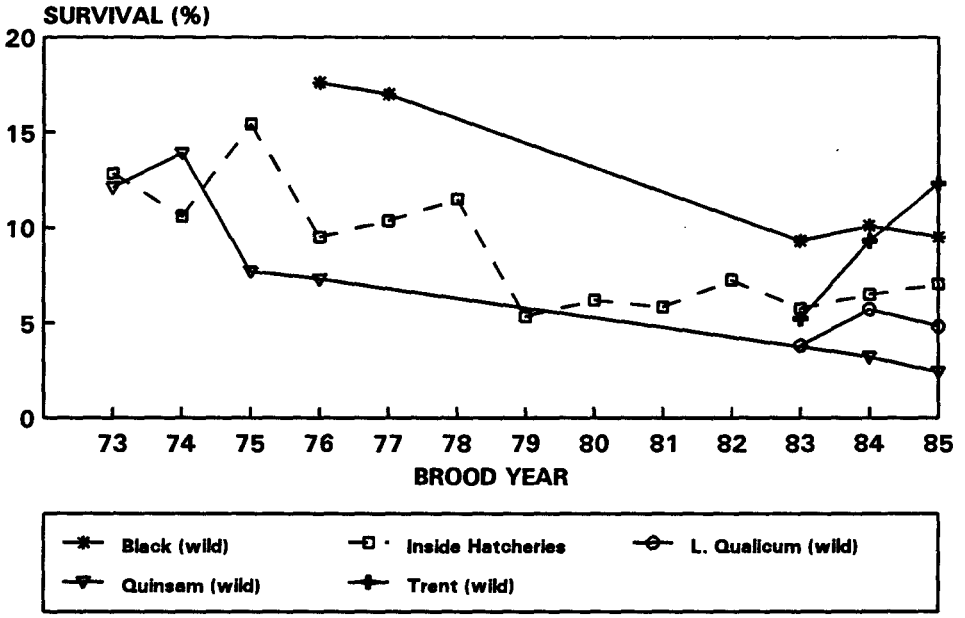
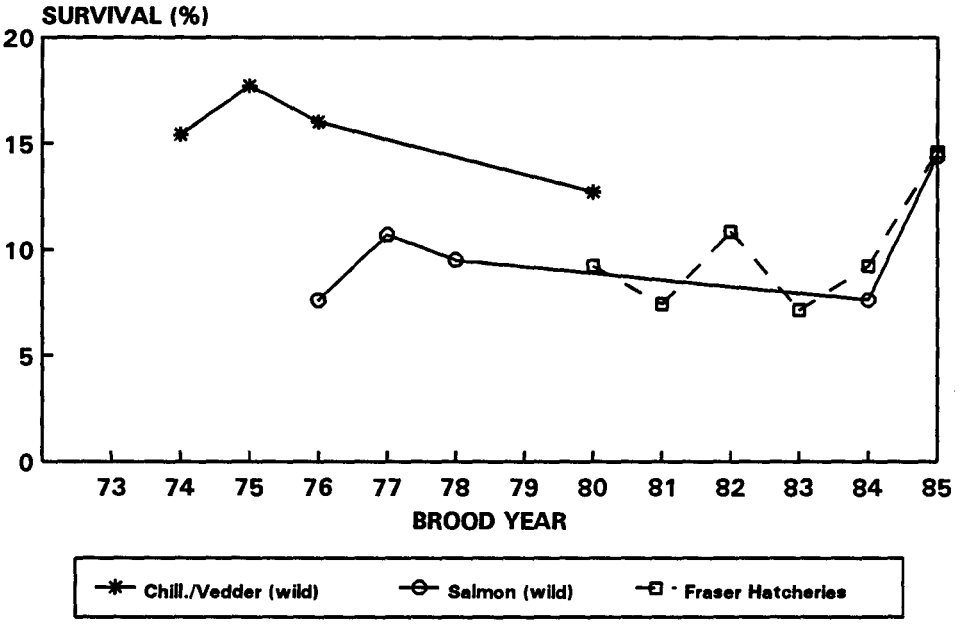


Fig 7: Survival to catch of Lower Fraser wild and hatchery coho smolts.



V. Recommendations

1. Quality of mark recovery and mark incidence data should be improved:

   - initial efforts in Canadian fisheries should be directed at the poorest quality data sources - outside sport fisheries and Indian food fisheries.
   - evaluation of the quality of U.S. data should proceed quickly once sufficient data have been exchanged.
   - sampling of naturally spawning populations containing enhanced fish should be expanded

2. Quality of catch and escapement estimates should be improved:

   - for Canadian fisheries priority should be given to sport fisheries outside Georgia Strait, for freshwater fisheries and for food fisheries. Methods to improve troll catch records by statistical area should be improved. Studies to evaluate the net catch of juvenile salmon should be continued.
   - escapement estimates to natural spawning areas of selected enhanced streams should be improved.

3. Methods should be developed and implemented to improve the accuracy of hatchery unmarked release estimates.

4. Marking of wild coho stocks should continue, with emphasis on using stocks with a marking history and obtaining subsequent escapement data. Further analysis of the wild and hatchery coho smolt survival-to-catch data presented herein is recommended.

5. Methods should be developed for marking wild chinook stocks.

6. Methods should be developed and implemented for mass marking hatchery juveniles in an economic and biologically feasible manner. Such methods would resolve many difficulties with mark recovery data.

LITERATURE CITED

Anonymous. 1990. Pacific Salmon Commission joint technical committee 1989 annual report. REPORT TCCHINOOK (90)-3. 95 p. + appendices.

Bilton, H. T., D. F. Alderdice, and J. T. Schnute. 1982. Influence of time and size at release of juvenile coho salmon (Oncorhynchus kisutch) on returns at maturity. Can. J. Fish. Aquat. Sci. 39: 426-447.

Bilton, H. T., A. S. Colburn, and R. B. Morley. 1983. Time and size at release experiment: Four releases of three size categories of juvenile chinook salmon from Quinsam hatchery in the spring of 1982. Can. Data Rep. Fish. Aquat. Sci. 397: 18 p.

Bilton, H. T. 1984. Returns of chinook salmon in relation to juvenile size at release. Can. Tech. Rep. Fish. Aquat. Sci. 1245: 33 p.

Cross, C. L. and E. A. Perry. 1985. Fish releases in 1982 from British Columbia Salmonid Enhancement Operations facilities. Can. Data Rep. Fish. Aquat. Sci. 528: 86 p.

English, K., W. J. Gazey, M. A. Labelle, T. M. Webb and E. A. Perry. 1988. Assessment of methods and data used to determine hatchery coho and chinook production for the Big Qualicum, Capilano, Robertson Creek, Puntledge and Quinsam hatcheries. Unpubl. rep. by LGL Limited for Fisheries and Ocean Canada. 105 p. + appendices.

Fraser, F. J., P. J. Starr, and A. Y. Fedorenko. 1982. A review of the chinook and coho salmon of the Fraser River. Can. Tech. Rep. Fish. Aquat. Sci. 1126: 130 p.

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

McLean, W. E., H. W. Genoe, C. Beggs, and C. Hillier. 1984. Pond inventory experiments using the mark/recapture technique - Puntledge Hatchery, 1983/84. Draft Rep. Dept. Fisheries and Oceans. Puntledge Hatchery, Courtenay, B. C.

PMFC. 1982. Workshop on coded-wire tagging experimental design, results and recommendations. Silver Creek Falls, Oregon, March 3 - April 2, 1982. Pacific Marine Fisheries Commission unpublished report. 40 p.

Rosberg, G. E. and J. Millar. 1987. Juvenile chinook and coho migration monitoring in the lower reach of the Fraser River mainstem, 1985-1986. Unpublished report for Fisheries and Oceans Canada, New Westminster, B. C. 82 p. + appendices.

Shepherd, B. G. 1984. The biological design process used in the development of federal government facilities during Phase I of the Salmonid Enhancement Program. Can. Tech. Rep. Fish. Aquat. Sci. 1275: v + 188 p.

Appendix A. Production capacity for SEP facilities - 1988 brood year.

PROGRAM	FACILITY	SPECIES	CAPACITY* ADULTS	UNFED FRY	FED FRY	SMOLTS
NORTH						
	North Coast					
CIU	KLOIYA CREEK	Chinook	396	0	0	36000
CIU	OLDFIELD CREEK	Coho	3024	0	16200	27000
		Chinook	277	0	0	25200
CIU	OONA RIVER	Coho	210	0	10500	0
CIU	PR.RUPERT SCHOOLS	Coho	-	-	-	-
	Nass					
CIU	KINCOLITH	Coho	7560	0	40500	67500
		Chinook	2070	0	72000	67500
CIU	TSEAX RIVER	Coho	1620	0	81000	0
	Rivers Inlet					
CIU	OWEEKENO	Chinook	2592	0	0	216000
DD	NEKITE RIVER	Coho	5000	625000	0	0
CIU	RIVERS INLET-HAKAI	Chinook	2592	0	0	216000
	Skeena					
RRU	ANDESIDE CHANNEL	Coho	157	0	0	1050
CIU	BULK.VALLEY SCHOOLS	Coho	-	-	-	-
CIU	BURNS LAKE SCHOOLS	Coho	-	-	-	-
CIU	EBY STREET	Coho	8100	0	405000	0
CIU	FORT BABINE	Coho	11745	0	81000	101250
		Chinook	2817	0	0	173250
OPS	FULTON RIVER	Coho	-	-	-	-
CIU	KISPIOX RIVER	Coho	17550	0	0	175500
		Chinook	2416	0	243000	54000
CIU	KITSUMKALUM RIVER	Coho	7452	0	113400	40500
RRU	KITWANCOOL CHAN.	Coho	30	0	0	200
OPS	PINKUT CREEK	Coho	-	-	-	-
CIU	SOCKEYE CREEK	Coho	2430	0	121500	0
CIU	STEWART SCHOOLS	Coho	-	-	-	-
CIU	TERRACE	Coho	3375	0	0	33750
		Chinook	4578	0	108000	196875
CIU	TERRACE SCHOOLS	Coho	-	-	-	-
CIU	TOBOGGAN CR	Coho	12150	0	0	121500
		Chinook	1215	0	0	60750

* dashes (-) indicate that although the species is produced the design capacity is unspecified

CIU - Community Involvement Unit - Community Programs Division
OPS - Enhancement Operations Division
DD - Development Division
RRU - Resource Restoration Unit - Community Programs Division

Appendix A. Production capacity for SEP facilities - 1988 brood year.

PROGRAM	FACILITY	SPECIES	ADULTS	CAPACITY UNFED FRY	CAPACITY FED FRY	CAPACITY SMOLTS
	Central Coast					
CIU	BELLA BELLA	Coho	8437	0	0	84375
CIU	BELLA COOLA	Coho	3070	80000	121500	0
CIU	CENTRAL COAST SCHOOLS	Coho	-	-	-	-
CIU	HARTLEY BAY CREEK	Coho	10152	0	372600	27000
OPS	KITIMAT RIVER	Coho	55000	0	0	550000
		Chinook	25920	0	0	2160000
CIU	KITIMAT SCHOOLS	Coho	-	-	-	-
CIU	KLEMTU	Coho	8437	0	0	84375
OPS	SNOOTLI CREEK	Coho	-	-	-	-
		Chinook	23328	0	0	1944000
	Queen Charlotte Islands					
CIU	AGNES CREEK	Coho	576	0	28800	0
CIU	BLAINE CREEK	Coho	864	0	43200	0
CIU	CHOWN BROOK	Coho	450	0	18000	0
CIU	COATES CREEK	Coho	2160	0	72000	0
CIU	GORE BROOK	Coho	2025	0	81000	0
CIU	HOME CREEK	Coho	810	0	32400	0
CIU	JARVIS CREEK	Coho	360	0	14400	0
CIU	LAWN CREEK	Coho	1212	63000	28350	0
CIU	MASSET	Coho	6750	0	0	67500
		Chinook	3960	0	0	360000
CIU	NADU CREEK	Coho	1111	63000	24300	0
OPS	PALLANT CREEK	Coho	7897	0	315900	0
		Chinook	-	-	-	-
CIU	PT.CLEMENTS R&G	Coho	1012	0	40500	0
CIU	QUEEN CHAR.SCHOOLS	Coho	-	-	-	-
CIU	SACHS CREEK	Coho	1012	0	40500	0
CIU	SEWELL INLET	Coho	2025	0	81000	0
CIU	SKIDEGATE	Coho	1215	0	48600	0
	Yukon					
OPS	WHITEHORSE	Chinook	3800	0	380000	0

Appendix A. Production capacity for SEP facilities - 1988 brood year.

PROGRAM	FACILITY	SPECIES	CAPACITY ADULTS	UNFED FRY	FED FRY	SMOLTS
INSIDE						
Georgia Strait Mainland						
CIU	ANDERSON CR	Coho	1620	0	81000	0
RRU	B.C.RAIL.CHAN.	Coho	450	0	0	3000
CIU	BEDWELL BAY	Chinook	-	-	-	-
RRU	BRANDT CR CHANNEL	Coho	450	0	0	3000
RRU	BRANDT CR DIVERSION	Coho	225	0	0	1500
RRU	BRENNAN PARK CHAN	Coho	337	0	0	2250
OPS	CAPILANO RIVER	Coho	55000	0	250000	500000
		Chinook	44200	0	0	2600000
CIU	COAST MOUNTAIN	Coho	360	0	18000	0
CIU	DELTA SCHOOLS	Coho	-	-	-	-
CIU	DRYDEN CREEK	Coho	162	0	8100	0
RRU	HIXON CHANNEL	Coho	180	0	0	1200
CIU	HORSESHOE BAY	Coho	9500	0	0	95000
		Chinook	-	-	-	-
CIU	HOWE SD. SCHOOLS	Coho	-	-	-	-
RRU	JUDD SLOUGH	Coho	1170	0	0	7800
CIU	KEITH CREEK	Coho	-	-	-	-
CIU	LANG CHANNEL	Coho	375	0	0	2500
CIU	LITTLE CAMPBELL R	Coho	2646	0	64800	13500
		Chinook	612	0	0	36000
RRU	MAMQUAM RIVER	Coho	675	0	0	4500
RRU	MASHITER CHANNEL	Coho	750	0	0	5000
CIU	MCKAY CREEK	Coho	320	40000	0	0
CIU	MCNAB CHANNEL	Coho	225	0	0	1500
		Coho	225	0	0	1500
RRU	MOODIE'S CHAN.	Coho	1485	0	0	9900
CIU	MOSSOM CREEK	Coho	648	0	32400	0
CIU	MYRTLE CREEK	Coho	810	0	40500	0
CIU	N VAN OUT SCHOOL	Coho	648	0	32400	0
CIU	NICOMEKL RIVER	Coho	-	-	-	-
CIU	NOONS CREEK	Coho	1687	0	0	16875
CIU	NORTH VAN. SCHOOLS	Coho	-	-	-	-
CIU	OUELLETTE CREEK	Coho	2646	0	64800	13500
RRU	PARADISE CHAN LOWER	Coho	675	0	0	4500
RRU	PARADISE CHAN UPPER	Coho	1170	0	0	7800
CIU	POWELL R.SCHOOLS	Coho	-	-	-	-
CIU	POWELL RIVER	Coho	39555	0	36000	384750
		Chinook	1468	0	0	86400
CIU	REED POINT	Chinook	-	-	-	-
CIU	RICHARDS CREEK	Chinook	360	0	36000	0
CIU	RICHMOND SCHOOLS	Coho	-	-	-	-

Appendix A. Production capacity for SEP facilities - 1988 brood year.

PROGRAM	FACILITY	SPECIES	ADULTS	CAPACITY UNFED FRY	CAPACITY FED FRY	CAPACITY SMOLTS
	Georgia Strait Mainland-cont'd					
CIU	ROBERTS CREEK	Coho	810	0	40500	0
CIU	SECHELT	Coho	8437	0	0	84375
		Chinook	1836	0	0	108000
CIU	SERPENTINE RIVER	Coho	1215	0	60750	0
		Chinook	306	0	0	18000
CIU	SEYMOUR R	Coho	6750	0	0	67500
		Chinook	3182	0	0	187200
CIU	SLIAMMON RIVER	Coho	10044	0	64800	81000
		Chinook	612	0	0	36000
CIU	STEVESTON H.SCHOOLS	Chinook	121	0	16200	0
CIU	SUN.COAST SCHOOLS	Coho	-	-	-	-
OPS	TENDERFOOT CREEK	Coho	17600	0	0	176000
		Chinook	28679	0	0	1687000
CIU	TERMINAL CREEK	Coho	1080	0	36000	0
		Chinook	-	-	-	-
RRU	TIAMPO CHANNEL	Coho	450	0	0	3000
RRU	TOWER CHANNEL	Coho	225	0	0	1500
CIU	TYNEHEAD ZOO.SOC.	Coho	1620	0	81000	0
		Chinook	612	0	0	36000
RRU	VAN.BAY CHAN	Coho	75	0	0	500
CIU	VANCOUVER BAY	Coho	1539	0	28800	6750
		Chinook	3103	0	14400	165600
CIU	VANCOUVER SCHOOLS	Coho	-	-	-	-
CIU	WAKEFIELD CREEK	Coho	3375	0	0	33750
RRU	WELDWOOD CHANNEL	Coho	202	0	0	1350
CIU	WEST VAN.SCHOOLS	Coho	-	-	-	-
CIU	WHITTALL CREEK	Coho	-	-	-	-
CIU	WILSON CREEK	Coho	3375	0	0	33750
	Georgia Strait Vancouver Island					
RRU	BAYNES SOUND STR.	Coho	6736	0	437400	23625
OPS	BIG QUALICUM RIVER	Coho	127000	0	200000	1250000
		Chinook	130000	0	0	6500000
RRU	BONSALL SLOUGH	Coho	690	0	0	4600
OPS	CHEMAINUS RIVER	Coho	500	0	50000	0
		Chinook	4000	0	0	200000
CIU	COMOX VALLEY	Coho	4185	0	81000	33750
CIU	COURTENAY	Coho	5872	0	81000	33750
CIU	COURTENAY SCHOOLS	Coho	-	-	-	-
CIU	COWICHAN LAKE SCHOOLS	Coho	-	-	-	-
CIU	COWICHAN RIVER	Coho	4050	0	405000	0
		Chinook	46080	0	0	2304000
CIU	COWICHAN SCHOOLS	Coho	-	-	-	-
RRU	CRAIG CREEK	Coho	-	-	-	-
CIU	CRAIGFLOWER CREEK	Coho	-	-	-	-
CIU	DENMAN ISLAND	Coho	324	0	40500	0
RRU	ENGLISHMAN CHANNEL	Coho	562	0	0	3750
RRU	ENGLISHMAN RIVER	Coho	2025	0	202500	0
		Chinook	-	-	-	-

Appendix A. Production capacity for SEP facilities - 1988 brood year.

PROGRAM	FACILITY	SPECIES	ADULTS	CAPACITY UNFED FRY	CAPACITY FED FRY	CAPACITY SMOLTS
	Georgia Strait Vancouver Island-cont'd					
CIU	FRENCH CREEK	Coho	1215	0	121500	0
CIU	GOLDSTREAM RIVER	Coho	1620	0	162000	0
		Chinook	1440	0	144000	0
CIU	GULF IS.SCHOOLS	Coho	-	-	-	-
RRU	KITTY COLEMAN CR.	Coho	1215	0	121500	0
CIU	L COWICH SAL ENH SO	Coho	810	0	81000	0
OPS	LITTLE QUALICUM R	Chinook	80000	0	0	4000000
CIU	LITTLE RIVER/GSVI	Coho	1404	0	72900	6750
CIU	MALASPINA COLL.	Coho	3375	0	0	33750
CIU	MATTHEW CREEK	Coho	-	-	-	-
CIU	MILLARD CREEK	Coho	810	0	81000	0
		Chinook	360	0	36000	0
CIU	NANAIMO RIVER	Coho	9990	0	324000	67500
		Chinook	10080	0	0	504000
CIU	NANAIMO SCHOOLS	Coho	-	-	-	-
RRU	NANOOSE CREEK	Coho	-	-	-	-
CIU	OYSTER RIVER	Coho	4185	0	81000	33750
		Chinook	14400	0	0	720000
OPS	PUNTLEDGE RIVER	Coho	135300	0	1100000	1243000
		Chinook	90000	0	0	4500000
CIU	QUALICUM SCHOOLS	Coho	-	-	-	-
RRU	ROTARY PARK	Coho	600	0	0	4000
CIU	ROY CREEK	Coho	810	0	81000	0
CIU	SALTSPRING IS.	Coho	405	0	40500	0
CIU	SHAWNIGAN CREEK	Coho	810	0	81000	0
CIU	TOD CREEK	Coho	-	-	-	-
CIU	WALKER CREEK	Coho	607	0	60750	0
RRU	WESTHOLME CHAN	Coho	195	0	0	1300
	Johnstone Strait					
CIU	BEAR RIVER	Coho	-	-	-	-
CIU	CAMPBELL R SCHOOLS	Coho	15	0	792	0
CIU	CAMPBELL R. F&W CLUB	Coho	500	0	25000	0
CIU	CORTEZ IS	Coho	320	40000	0	0
CIU	GILLARD PASS	Coho	405	0	40500	0
		Chinook	121	0	16200	0
DD	KAKWEIKEN FISHWAY/JNST	Coho	375	46875	0	0
CIU	KOKISH RIVER	Coho	405	0	40500	0
		Chinook	720	0	0	36000
CIU	MEMEKAY RIVER	Coho	810	0	81000	0
		Chinook	3600	0	0	180000
CIU	NIMPKISH	Coho	2880	0	144000	0
		Chinook	5760	0	0	288000
CIU	P.HARDY/QUATSE	Coho	2025	0	202500	0
		Chinook	7200	0	0	360000
CIU	QUADRA I.ENH.SOC.	Coho	1440	0	144000	0
OPS	QUINSAM RIVER	Coho	123000	0	300000	1200000
		Chinook	60000	0	0	3000000
CIU	ROUGH BAY CR	Coho	-	-	-	-
CIU	SCOTT COVE CREEK	Coho	2430	0	243000	0
CIU	STUART ISLAND	Coho	405	0	40500	0
CIU	WARNER BAY CREEK	Coho	-	-	-	-

Appendix A. Production capacity for SEP facilities - 1988 brood year.

PROGRAM	FACILITY	SPECIES	ADULTS	CAPACITY UNFED FRY	CAPACITY FED FRY	CAPACITY SMOLTS
	Lower Fraser					
CIU	ABBOTSFORD SCHOOLS	Coho	-	-	-	-
RRU	ALOUETTE CHANNEL	Coho	360	0	0	2400
CIU	ALOUETTE RIVER	Coho	9450	0	0	94500
RRU	BILLY HARRIS SLOUGH	Coho	750	0	0	5000
CIU	BRUNETTE RIVER	Coho	3375	0	0	33750
CIU	BURNABY SCHOOLS	Coho	-	-	-	-
CIU	CENTRE CREEK	Coho	1620	0	81000	0
OPS	CHEHALIS RIVER	Coho	60750	0	0	607500
		Chinook	34637	0	0	2037500
OPS	CHILLIWACK RIVER	Coho	90000	0	0	900000
		Chinook	26010	0	0	1530000
CIU	CHILLIWACK SCHOOLS	Coho	-	-	-	-
RRU	CHILQUA CREEK	Coho	180	0	0	1200
CIU	COQUITLAM R	Coho	1274	0	6480	10800
RRU	ED LEON SLOUGH	Coho	750	0	0	5000
RRU	HICKS CREEK POND	Coho	600	0	0	4000
RRU	HOPEDALE CHANNEL	Coho	1170	0	0	7800
RRU	HOPEDALE SLOUGH	Coho	600	0	0	4000
OPS	INCH CREEK	Coho	32300	0	0	323000
		Chinook	-	-	-	-
CIU	KANAKA CREEK	Coho	4455	0	36000	33750
RRU	KAWKAWA CHANNEL	Coho	-	-	-	-
CIU	MISSION SCHOOLS	Coho	-	-	-	-
CIU	NEW WESTMINSTER SCHOOLS	Coho	-	-	-	-
RRU	PEACH CREEK	Coho	2025	0	0	13500
RRU	RAILROAD CREEK	Coho	37	0	0	250
RRU	SEABIRD CHANNEL	Coho	450	0	0	3000
CIU	SILVERMERE LAKE	Coho	1782	0	62100	0
RRU	SMOKEHOUSE CHAN.	Coho	308	0	0	2055
CIU	SURREY SCHOOLS	Coho	-	-	-	-
CIU	UNION CREEK	Coho	1600	200000	0	0
RRU	WORTH CREEK	Coho	1200	0	0	8000

Appendix A. Production capacity for SEP facilities - 1988 brood year.

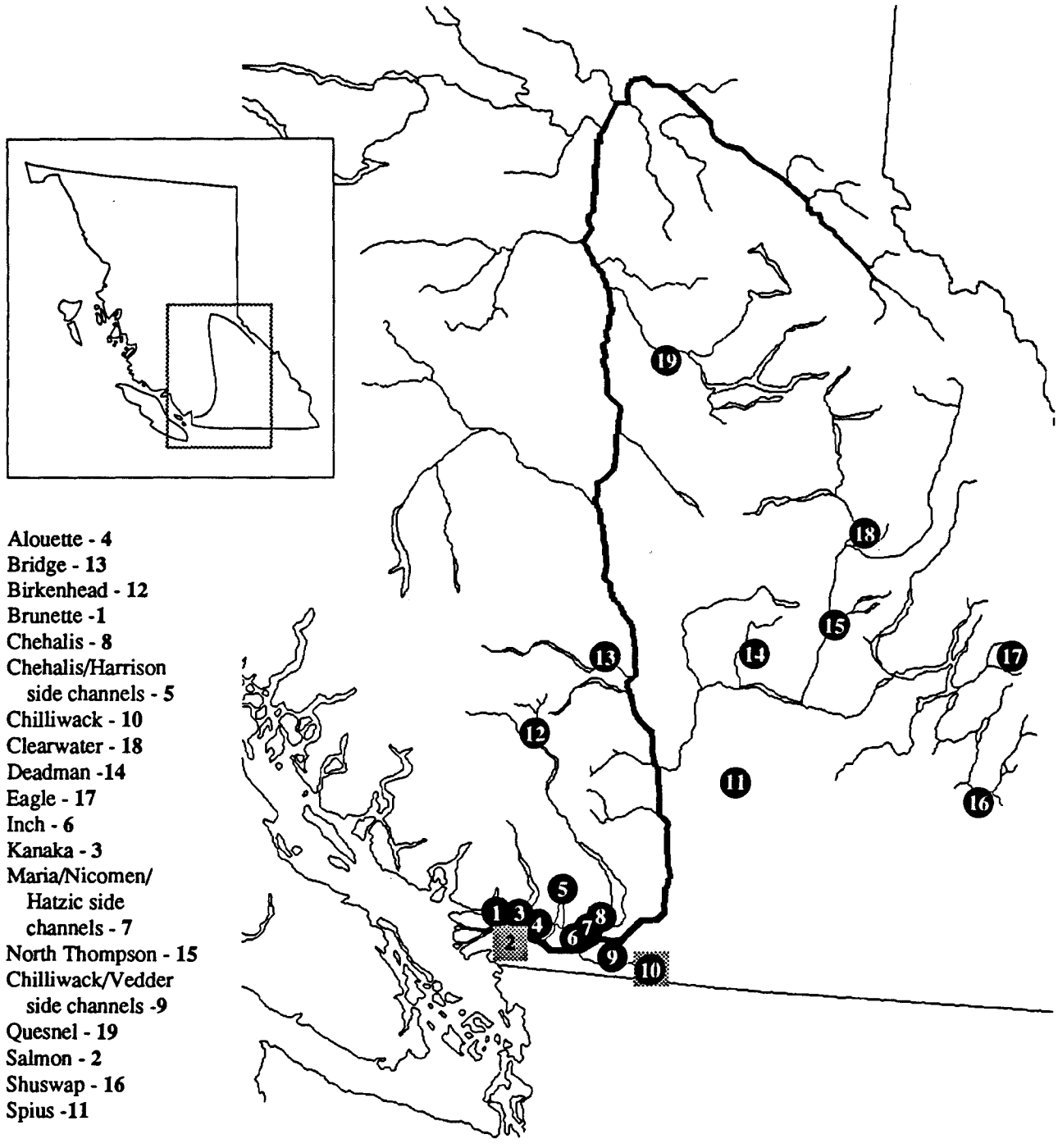
PROGRAM	FACILITY	SPECIES	ADULTS	CAPACITY UNFED FRY	CAPACITY FED FRY	CAPACITY SMOLTS
WEST COAST						
North West Van. Is.						
CIU	COLONIAL RIVER	Coho	2025	0	101250	0
		Chinook	-	-	-	-
OPS	CONUMA RIVER	Coho	11000	0	50000	100000
		Chinook	22820	0	0	1630000
CIU	CORDY CREEK	Coho	3240	0	162000	0
		Chinook	-	-	-	-
CIU	GOLD RIVER	Coho	7897	0	141750	50625
		Chinook	10080	0	0	720000
CIU	HECATE COVE CREEK	Coho	-	-	-	-
CIU	MARBLE RIVER	Coho	4050	0	202500	0
		Chinook	10080	0	0	720000
CIU	MONKEY CREEK	Coho	1782	0	89100	0
CIU	P.HARDY/STEPHENS	Coho	3888	0	324000	0
		Chinook	5040	0	0	360000
CIU	QUATSINO CREEK	Coho	64	8000	0	0
CIU	TAHSIS RIVER	Coho	810	0	40500	0
		Chinook	2520	0	0	180000
CIU	VAN I.WEST SCHOOLS	Coho	-	-	-	-
South West Van. Is.						
CIU	ALBERNI ENH SOC	Coho	3240	0	162000	0
CIU	ALBERNI SCHOOLS	Coho	32	4000	0	0
CIU	CLAYOQUOT	Coho	972	0	81000	0
		Chinook	3024	0	0	216000
OPS	NITINAT RIVER	Coho	4400	0	0	88000
		Chinook	2016	0	0	144000
OPS	ROBERTSON CREEK	Coho	50000	0	0	1000000
		Chinook	114240	0	0	8160000
CIU	SAN JUAN RIVER	Coho	11566	0	517590	24300
		Chinook	7056	0	0	504000
CIU	SOOKE RIVER	Coho	3591	0	145800	13500
		Chinook	-	-	-	-
CIU	THORNTON CREEK	Coho	7425	0	202500	67500
		Chinook	5040	0	0	360000
CIU	THORNTON VOL	Coho	2025	0	101250	0
CIU	TOFINO	Coho	1620	0	81000	0
		Chinook	180	0	18000	0

Appendix A. Production capacity for SEP facilities - 1988 brood year.

PROGRAM	FACILITY	SPECIES	ADULTS	CAPACITY UNFED FRY	CAPACITY FED FRY	CAPACITY SMOLTS
UPPER FRASER/THOMPSON						
Thompson						
CIU	ARMSTRONG/SHUSWAP SCHOOLS	Coho	-	-	-	-
		Chinook	-	-	-	-
OPS	CLEARWATER R UPR	Chinook	10800	0	0	1440000
RRU	DEADMAN CHAN.	Coho	180	0	0	1200
CIU	DEADMAN RIVER	Coho	6750	0	0	67500
		Chinook	2328	0	0	209250
OPS	EAGLE RIVER/THOM	Coho	17000	0	850000	0
		Chinook	5400	0	0	720000
CIU	FORTUNE CREEK	Coho	-	-	-	-
RRU	IANSON CHANNEL	Coho	339	0	0	2260
CIU	KAMLOOPS SCHOOLS	Coho	-	-	-	-
CIU	KINGFISHER CREEK	Coho	810	0	40500	0
		Chinook	1800	0	180000	0
CIU	LOUIS CREEK	Coho	972	0	48600	0
CIU	MERRITT SCHOOLS	Coho	-	-	-	-
CIU	NORTH THOM SCHOOLS	Coho	-	-	-	-
		Chinook	-	-	-	-
CIU	PR.GEORGE SCHOOLS	Chinook	-	-	-	-
OPS	SHUSWAP RIVER	Chinook	13950	0	0	1860000
OPS	SPIUS CREEK	Coho	13770	0	688500	0
OPS		Chinook	9765	0	0	1302000
CIU	THOMPSON RIVER NORTH	Coho	14472	0	81000	135000
Upper Fraser						
OPS	BIRKENHEAD RIVER	Chinook	3200	0	320000	0
CIU	BRIDGE RIVER	Coho	810	0	40500	0
		Chinook	270	0	0	36000
CIU	CARIBOO S. SCHOOLS	Coho	-	-	-	-
		Chinook	-	-	-	-
CIU	CHILAKO RIVER	Chinook	-	-	-	-
CIU	FORT ST JAMES	Chinook	675	0	32400	79200
CIU	PENNY CDP	Chinook	1226	0	72000	33750
LEP	QUESNEL LAKE	Coho	2133	0	72900	6750
OPS	QUESNEL RIVER	Coho	720	0	36000	0
		Chinook	23107	0	0	3081000
CIU	SPRUCE C.WLDLF ASSOC	Chinook	1080	0	108000	0
CIU	WILLIAMS LAKE SCHOOLS	Chinook	-	-	-	-

Appendix B. Locations of all hatcheries in B.C. producing chinook or with a production capacity of more than 2000 coho adults for the 1988 brood year.

Upper and Lower Fraser River and Thompson River Sites

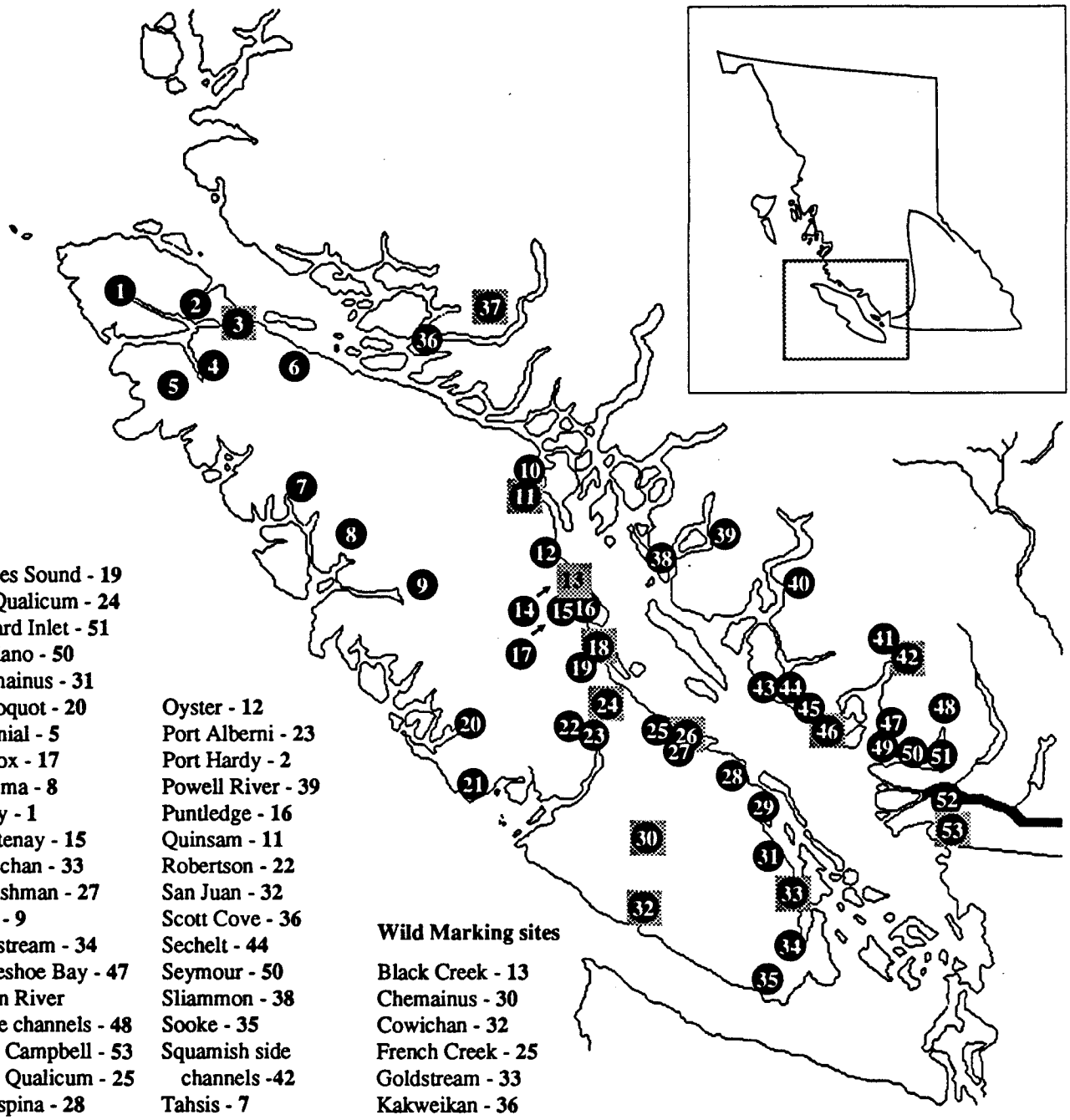


Alouette - **4**
Bridge - **13**
Birkenhead - **12**
Brunette -**1**
Chehalis - **8**
Chehalis/Harrison side channels - **5**
Chilliwack - **10**
Clearwater - **18**
Deadman -**14**
Eagle - **17**
Inch - **6**
Kanaka - **3**
Maria/Nicomen/ Hatzic side channels - **7**
North Thompson - **15**
Chilliwack/Vedder side channels -**9**
Quesnel - **19**
Salmon - **2**
Shuswap - **16**
Spius -**11**

Wild Marking Sites

Chilliwack - **10**
Salmon - **2**

Georgia Strait, Johnstone Strait, and Westcoast Vancouver Island Sites



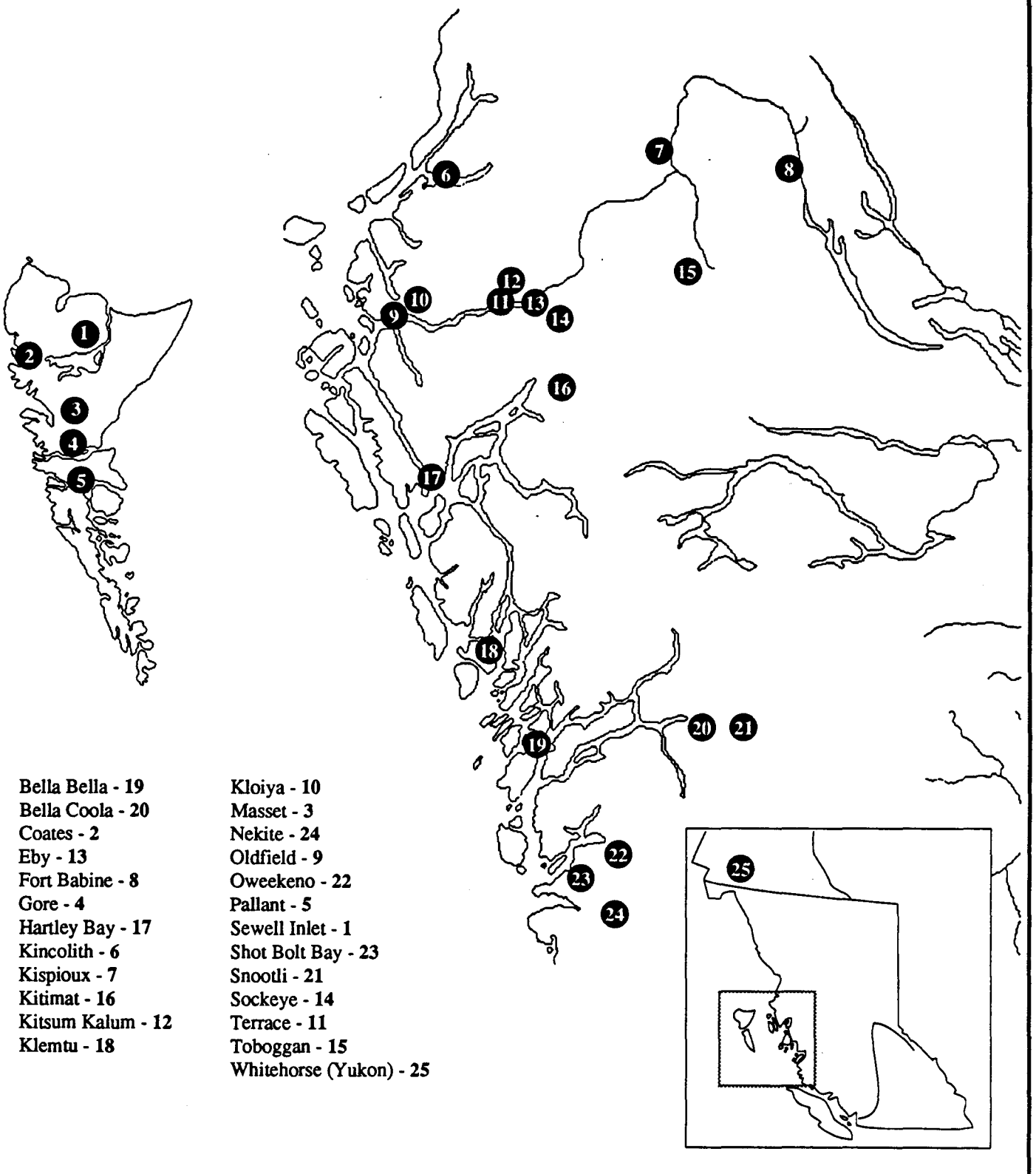
Baynes Sound - 19
Big Qualicum - 24
Burrard Inlet - 51
Capilano - 50
Chemainus - 31
Clayoquot - 20
Colonial - 5
Comox - 17
Conuma - 8
Cordy - 1
Courtenay - 15
Cowichan - 33
Englishman - 27
Gold - 9
Goldstream - 34
Horseshoe Bay - 47
Indian River side channels - 48
Little Campbell - 53
Little Qualicum - 25
Malaspina - 28
Marble - 4
Memekay - 10
Nanaimo - 29
Nimpkish - 6
Nitinat - 30
Ouellette - 46
Oyster - 12
Port Alberni - 23
Port Hardy - 2
Powell River - 39
Puntledge - 16
Quinsam - 11
Robertson - 22
San Juan - 32
Scott Cove - 36
Sechelt - 44
Seymour - 50
Sliammon - 38
Sooke - 35
Squamish side channels -42
Tahsis - 7
Tenderfoot - 41
Thornton - 21
Tynehead - 52
Vancouver Bay - 40
Wakefield - 43
Wilson - 45

Wild Marking sites

Black Creek - 13
Chemainus - 30
Cowichan - 32
French Creek - 25
Goldstream - 33
Kakweikan - 36
Keogh - 3
Little Campbell - 49
Little Qualicum - 24
Quinsam - 11
Squamish - 42
Trent - 17

Wild Marking Sites

North and Central Coast, Skeena, Nass, Rivers Inlet, and Queen Charlotte Sites



Bella Bella - 19
Bella Coola - 20
Coates - 2
Eby - 13
Fort Babine - 8
Gore - 4
Hartley Bay - 17
Kincolith - 6
Kispioux - 7
Kitimat - 16
Kitsum Kalum - 12
Klemtu - 18
Kloiya - 10
Masset - 3
Nekite - 24
Oldfield - 9
Oweekeno - 22
Pallant - 5
Sewell Inlet - 1
Shot Bolt Bay - 23
Snootli - 21
Sockeye - 14
Terrace - 11
Toboggan - 15
Whitehorse (Yukon) - 25

Appendix C. Method for estimating contribution of unassociated releases.

Steps involved in calculating the unassociated contribution were as follows:

1. Down-load all SEP unassociated releases from the MRP finclip release file into Framework spreadsheets and databases.

2. Sort and sum release data into 4 major production region groupings and 3 major release stage groupings by brood year (Tables C1 and C2).

3. Calculate the average unweighted survival to catch for comparable tagged groups for each production region and release stage grouping by brood year (Tables C3 and C4). Where comparable releases did not exist, the average survival for the previous or following 2 - 3 brood years was used. If there were insufficient data for an average, an adjacent production region or an alternate release stage were used. If a survival seemed atypically high, particularly if based on a small sample of tag codes, survival was adjusted downwards using adjacent release stages or alternative release stages. Survivals were never adjusted upwards.

4. Multiply releases by appropriate survival rates to generate total contribution by brood year.

5. Calculate the percentage of each total contribution group available to Canadian fisheries by multiplying the total contribution by the contribution to Canadian fisheries of marked groups.

6. Divide the total available to Canadian fisheries into recovery year classes by multiplying by the average percentage at age for the production regions (Tables C5 and C6).

7. Sum component age class contribution for each recovery year to generate total contribution to Canadian fisheries by recovery year.

8. Divide unassociated contribution into catch region based on the percent contribution of marked fish to each catch region.

Table C1. Unassociated chinook releases by production area and brood year.

	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
NORTH																	
Fed Fry			18609				30000	120000	300	4930	74800	71137	186959	140311	193435	273105	202078
Smolts						1216	2853		12093	56635	352	437947	147055	208956	733931	716111	874578
1+ smolts							1226						115	1601	44136	91846	45047
TOTAL	0	0	18609	0	0	1216	34079	120000	12393	61565	75152	509084	334129	350868	971502	1081062	1121703
INSIDE																	
Fed Fry	169019							726	310160	192855	72721	74721	348513	133994	260164	102173	90517
Smolts	19831										120792	51864	585812	663815	812148	1824129	1761931
1+ smolts												3164	2157	298	14602		
TOTAL	188850	0	0	0	0	0	0	726	310160	192855	193513	129749	936482	798107	1086914	1926302	1852448
WEST COAST																	
Fed Fry							237245	2426342	400000		3400		355298	45761	53816	4348	1976111
Smolts		38631		35411			18268	13717	355134	39560		38450	159635	230955	365901	1938031	1507489
1+ smolts																	
TOTAL	0	38631	0	35411	0	0	255513	2440059	755134	39560	3400	38450	514933	276716	419717	1942379	3483600
UPPER FRASER																	
Fed Fry											13275	366582	41000	83500	142013	394291	370744
Smolts										7999			400	152087	355902	763587	859302
1+ smolts															309		38149
TOTAL	0	0	0	0	0	0	0	0	0	7999	13275	366582	41400	235587	498224	1157878	1268195
TOTAL																	
Fed Fry	169019	0	18609	0	0	0	267245	2547068	710460	197785	164196	512440	931770	403566	649428	773917	2639450
Smolts	19831	38631	0	35411	0	1216	21121	13717	367227	104194	121144	528261	892902	1255813	2267882	5241858	5003300
1+ smolts	0	0	0	0	0	0	1226	0	0	0	0	3164	2272	1899	59047	91846	83196
TOTAL	188850	38631	18609	35411	0	1216	289592	2560785	1077687	301979	285340	1043865	1826944	1661278	2976357	6107621	7725946

Table C2. Unassociated coho releases by production area and brood year.

	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
NORTH																	
Fry-before Sept.1							20000	38817	40100	39965	456639	947699	932102	696711	600311	1330633	742057
Fry-after Sept.1									25900		24534		124232	78655	191101	250370	229226
Smolts													92256	460788	56434	131019	86944
TOTAL	0	0	0	0	0	0	20000	38817	66000	39965	481173	947699	1148590	1236154	847846	1712022	1058227
INSIDE																	
Fry-before Sept.1	785855	0	0	136835	0	524516	1010241	412109	2630729	1285336	2031451	3104308	1551795	2852070	2842272	2978458	2773761
Fry-after Sept.1							61833	8900	8000	12250	527124	33999	324505	1159618	725428	782186	287864
Smolts					38636	540		5300	49669	119752	37077	360034	426248	484353	839879	835991	705204
TOTAL	785855	0	0	136835	38636	525056	1072074	426309	2688398	1417338	2595652	3498341	2302548	4496041	4407579	4596635	3766829
WEST COAST																	
Fry-before Sept.1			160578				781994	235196	807345	206826	855718	2560778	550754	1916705	1187803	2336459	929638
Fry-after Sept.1										9000	49000		4000	80000		21000	85430
Smolts													53267	44743	68259	203057	78453
TOTAL	0	0	160578	0	0	0	781994	235196	807345	215826	904718	2560778	608021	2041448	1256062	2560516	1093521
UPPER FRASER																	
Fry-before Sept.1								4000	450	24300	19600	69850	89179	270066	33234	361602	231275
Fry-after Sept.1															9500	32653	
Smolts															23100	1200	
TOTAL	0	0	0	0	0	0	0	4000	450	24300	19600	69850	89179	270066	65834	395455	231275
TOTAL																	
Fry-before Sept.1	785855	0	160578	136835	0	524516	1812235	690122	3478624	1556427	3363408	6682635	3123830	5735552	4663620	7007152	4676731
Fry-after Sept.1	0	0	0	0	0	0	61833	8900	33900	21250	600658	33999	452737	1318273	926029	1086209	602520
Smolts	0	0	0	0	38636	540	0	5300	49669	119752	37077	360034	571771	989884	987672	1171267	870601
TOTAL	785855	0	160578	136835	38636	525056	1874068	704322	3562193	1697429	4001143	7076668	4148338	8043709	6577321	9264628	6149852

Table C3. Survival rate for unassociated chinook releases by production area and brood year.

	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
NORTH																	
Fed Fry			.07		.05	.07	.07	.22	.22	.31	.21	.04	.12	.04	.07	.07	.07
Smolts					.52	.37	.58	.87	1.05	.92	.77	.28	.23	.34	.28	.28	.28
1+ smolts							.28						.28	.28	.28	.28	.28
INSIDE											*						
Fed Fry	2.24	.95		2.24				2.24	4.58	1.86	2.24	2.27	.25	2.24	2.24	2.24	2.24
Smolts	3.64	.89	3.56	6.48	1.88	5.55	1.09	.97	2.27	1.81	1.75	1.41	.88	1.04	1.11	1.11	1.11
1+ smolts						4.30	2.05	7.11				2.61	2.61	2.61	2.61	2.61	2.61
WEST COAST																	
Fed Fry				.76			.99	.99	1.50	.50	.99		.99	.99	.99	.99	.99
Smolts		1.01	.97	6.12	3.10	3.89	.95	1.86	1.53	1.36	.58	.44	.21	.34	.33	.33	.33
1+ smolts																	
UPPER FRASER																	
Fed Fry							.27	.20		.03	.06	.02	.06	.05	.05	.05	.05
Smolts									.05	.04	.08	.09	.10	.07	.09	.09	.09
1+ smolts														.08	.05	.07	.06

Note: Underlined values have been calculated.

*Calculated value subsituted as survival (7.8%), based on one tag code, seemed anamolous.

Table C4. Survival rate for unassociated coho releases by production area and brood year.

	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
NORTH																	
Fry-before Sept.1							1.75	1.75	1.75	2.64	1.37	1.25	.83	2.40	1.40	1.54	1.54
Fry-after Sept.1									.31	.28	.31		.46	.31	.20	.31	.31
Smolts										2.68			4.96	2.25	3.60	3.60	3.60
INSIDE																	
Fry-before Sept.1	2.36			2.36		2.36	2.36	2.36	2.36	1.82	3.03	2.22	1.11	.85	.56	.84	.84
Fry-after Sept.1							4.18	2.74	1.97	1.86	2.19	2.93	4.07	2.45	3.15	3.15	3.15
Smolts		26.37	33.76	13.36	16.45	16.38	14.42	8.87	7.65	10.15	8.56	12.34	8.44	9.83	10.20	9.49	9.49
WEST COAST																	
Fry-before Sept.1			1.10				1.10	1.10	1.10	1.10	.53	1.21	1.56	.77	1.18	1.18	1.18
Fry-after Sept.1											.53	1.10	1.56	.77	1.18	1.18	1.18
Smolts		6.95	9.91	9.08	8.05	9.93	5.53	2.84	2.21	6.40	7.70	3.05	7.62	4.00	2.02	4.55	4.55
UPPER FRASER																	
Fry-before Sept.1								1.00	1.00	1.00	1.00	1.74	.45	.82	.91	.72	.72
Fry-after Sept.1													1.67	1.74	1.48	1.63	1.63
Smolts														3.19	3.77	3.48	3.48

Note: Underlined values have been calculated.

Table C5. Summary of chinook age composition used for calculating contribution of unassociated releases.

Production Region	% at age		
	2	3	4
North	6.00	14.00	29.00
Inside	35.00	45.00	18.00
West Coast	9.00	35.00	44.00
Upper Fraser	.00	10.00	40.00

Table C6. Summary of coho age composition used for calculating contribution of unassociated releases.

Production Region	% at age	
	2	3
North	10.00	90.00
Inside	5.00	95.00
West Coast	15.00	85.00
Upper Fraser	5.00	95.00