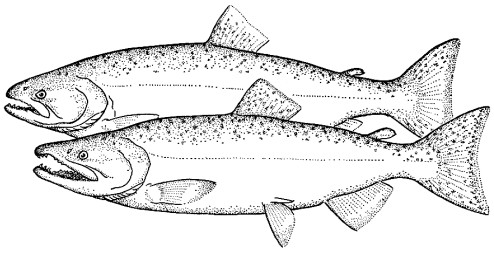


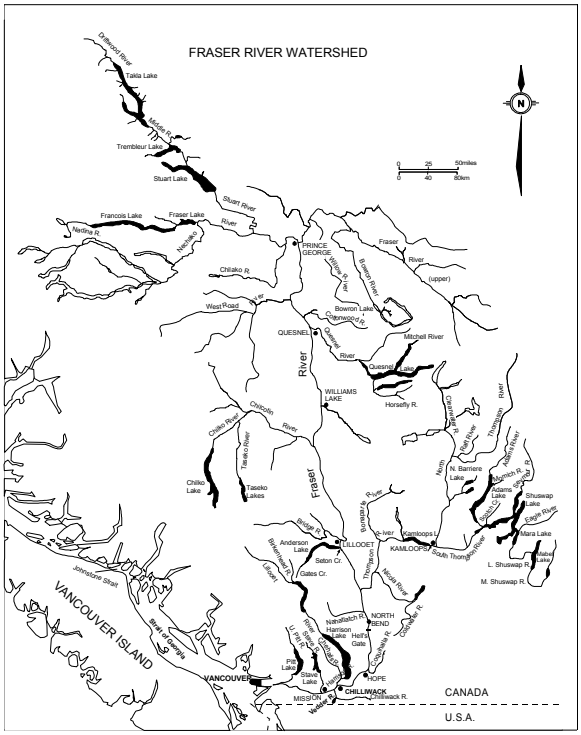
Fraser River Chinook Salmon

Background

The Fraser River watershed is the largest Canadian producer of chinook salmon. Most Fraser-origin chinook spawn in the middle and upper regions of the watershed, the most notable exception being the Harrison River population in the lower Fraser. Chinook return to the Fraser throughout the year, with most non-Harrison fish arriving in the lower Fraser between April and September. Harrison fish enter the lower Fraser during September to November.

Fraser chinook spawn primarily from August to December, and most spawners are 3, 4, or 5 years old. Fry emerge the following spring and those that spend one or more years in freshwater are called "stream type," while those that rear in freshwater less than one year (typically less than 6 months) are "ocean type." Harrison fish are unusual in that they are all white-fleshed (most non-Harrison chinook are pink-fleshed) and migrate as recently emerged fry directly to the lower Fraser River and its estuary.

Fraser chinook are comprised of a large number of populations. For management purposes, they are divided into 4 major geographical stock complexes, and 3 timing groups. The geographical stock strata are: upper Fraser (those upstream of Prince George and including Nechako), middle Fraser (downstream of Prince George but excluding the Thompson), the Thompson, and the lower Fraser (numerically dominated by fall-returning Harrison-origin fish). The timing groups are categorized into 3 seasonal runs. The early or spring run migrates through the lower Fraser River before July 15; the summer run migrates through the lower Fraser between July 15 and Sept. 1.; and the fall chinook, mostly originating in the Harrison and Chilliwack, enter the lower Fraser after Sept. 1. The geographical and timing complexes overlap. For assessment purposes, geographic stock aggregates are grouped according to their timing and life history.



Map of Fraser River watershed.

Since the early 1980s, the principal hatcheries enhancing Fraser chinook have been the Chehalis and Chilliwack (lower Fraser), Eagle, Shuswap Falls, Clearwater, Deadman Creek, and Spius Creek (all Thompson) and the Quesnel (mid-Fraser) and Stuart/ Narcoslie (upper Fraser). In recent years, the Clearwater, Eagle, Quesnel, and Stuart facilities have closed. Some enhancement also occurs at small facilities throughout the watershed. Enhancement is thought to have a relatively small effect on the total numbers of chinook returning to the Fraser, although the effects on certain watersheds, such as the Nicola watershed, which is enhanced by the Spius Creek Hatchery, and the Chilliwack River, which is enhanced by the Chilliwack Hatchery, can be significant.

The Fishery

Under the 1985 Pacific Salmon Treaty, Canada and the U.S. committed to halting the decline of chinook escapements. Catch ceilings were established for major chinook fisheries from Alaska to British Columbia and various time and area closures were implemented. Since 1994, additional fishery management changes have been made to increase the size of spawning stocks of upper Fraser River and other chinook stocks. These have included reduced catch ceilings for the troll fisheries, and increased minimum size limits and reduced bag limits for the recreational fishery. In 1997 and 1998, Canadian ocean fisheries were dramatically reduced to lessen impacts on Thompson basin coho, further altering marine catch distributions and lowering ocean catches of Fraser chinook.

Estimates of the distribution of Fraser chinook are based on data gathered during coded-wire tag (CWT) studies. Because of recent changes in the fishery, catch distribution results were divided into pre- and post-1997 when there were sufficient data to do so. Recoveries for all tags were grouped into one of 7 recovery strata:

Recovery Stratum	Fishery / Mark Recovery Areas Included
North, Central	All northern and central net, troll and sport fisheries
WCVI, Entrances	All WCVI, Johnstone St. and Juan de Fuca St. fisheries
Inside	All Georgia Strait troll, net and sport fisheries
Fraser River Commercial	Fraser gillnet, seine, and test fisheries
Fresh Water Sport	All Fraser River recreational fishery recoveries
Alaska	Alaskan troll, seine, and gillnet recoveries
Washington / Oregon	Washington, Oregon and California fisheries

All CWT information is presented as "estimated tags," – the numbers of tags recovered in the time-area-fishery stratum– expanded to account for the catch/sample ratio. In many instances, sample sizes are small, and our understanding of chinook distribution is limited as a consequence. First Nations fisheries in the Fraser have not been adequately sampled for CWTs, and are therefore excluded from the recovery strata.

Spring-Run Chinook

Recoveries of upper Fraser spring-run chinook were rare considering the numbers of CWTs applied, and these tags were recovered in all strata (Fig. 1). Most tags were from the WCVI/Entry area. Early returning chinook to the upper Fraser are rarely available to coastal fisheries during July, but are available to entrance and recreational fisheries in May and June during their return migrations.

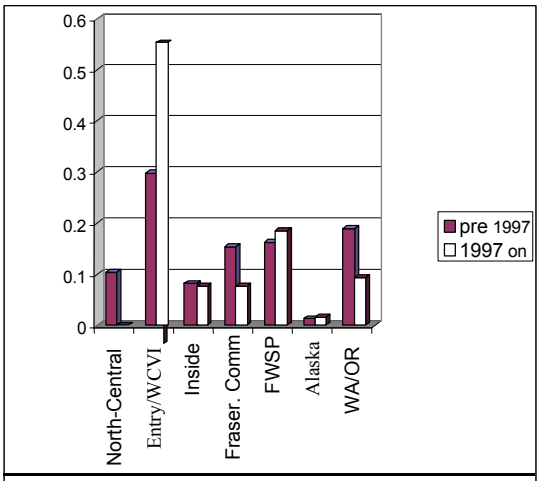


Fig. 1. Distribution of estimated CWT recoveries of upper Fraser spring-run chinook before (n=875), and during or after (n=65), 1997.

There currently are no CWT application programs for mid-Fraser spring-run chinook. A total of 504 CWTs were estimated to have been recovered coastwide from earlier tagging. Similar to upper Fraser springs, most recoveries occurred in the WCVI/Entry area, and many of these were caught in the Juan de Fuca recreational fishery during June.

A greater proportion of chinook originating in the North and South Thompson were recovered in the north and central recovery areas than occurred for mid and upper Fraser spring chinook (Fig. 2). Freshwater sport recoveries were almost exclusively in the lower Fraser River bar fishery, as there were no terminal sport fisheries targetting these (marked) stocks.

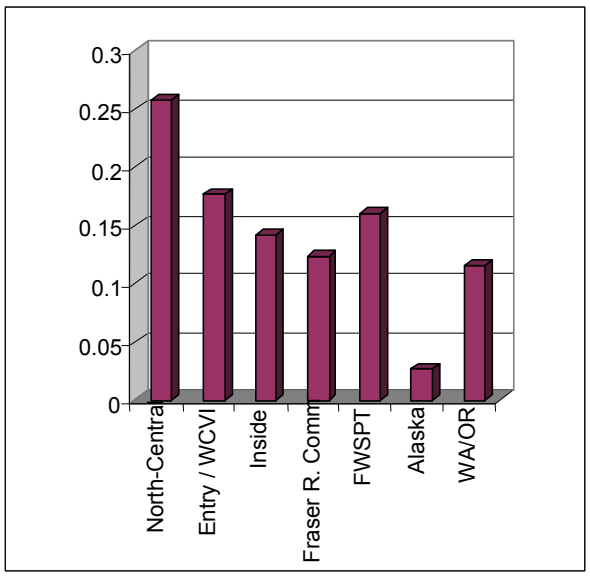


Fig. 2. Distribution of estimated CWT recoveries of North and South Thompson spring-run chinook (n=485).

Prior to the closure of many of the outside commercial fisheries, recoveries of lower Thompson springs occurred in all strata with the exception of Alaska, but were most common in the WCVI/Entry area (Fig. 3). From 1997 on, the number of recoveries in all fisheries declined, with the exception of the terminal and lower river recreational fisheries. While these sport fisheries recovered almost 70 % of all lower Thompson CWTs during 1997-98, they represented only 87 tagged fish, of which 65 were caught in the terminal recreational fisheries at the mouth of the Nicola River.

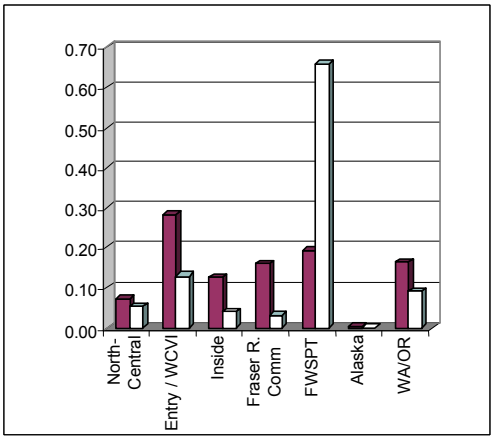


Fig. 3. Distribution of estimated CWT recoveries of lower Thompson spring-run chinook before (n=3692), and during or after (n=133), 1997.

Early returning spring chinook from the Birkenhead River (upper Harrison system) had a very different marine catch distribution than any other Fraser River spring chinook population (Fig. 4). Most Birkenhead chinook, one of the earliest returning populations to the Fraser, were recovered in Alaskan fisheries. Recoveries inside the Strait of Georgia occurred during early spring recreational fisheries.

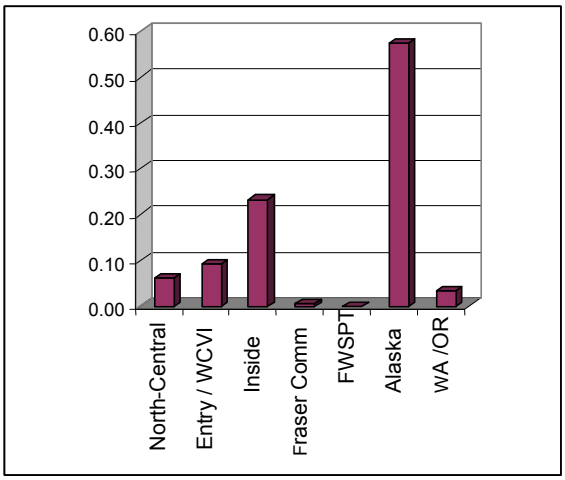


Fig. 4. Distribution of estimated CWT recoveries of Birkenhead spring-run chinook (n=398).

Summer-Run Chinook

Recoveries of upper Fraser summer-run chinook (mostly Stuart) occurred most frequently in the entry fisheries and off the west coast of Vancouver Island, with the southwest Vancouver Island troll fishery and Juan de Fuca net fisheries being the primary contributors (Fig. 5). Few recoveries were reported in recreational fisheries and recoveries in the Fraser River commercial fishery occurred mostly during sockeye openings.

Recovery information for mid-Fraser summer chinook is presented in aggregate for mid-Fraser populations pre-1997, and for Quesnel River fish in 1997 and 1998 (Fig. 6). Mid-Fraser summers were, prior to 1997, recovered often in entrance net fisheries, although more recently, most recoveries occurred in northern and Alaskan fisheries, and in directed sockeye fisheries in the Fraser. Alaskan recoveries occurred primarily in troll fisheries. Very few recoveries were reported

in the Strait of Georgia fisheries or in freshwater sport fisheries.

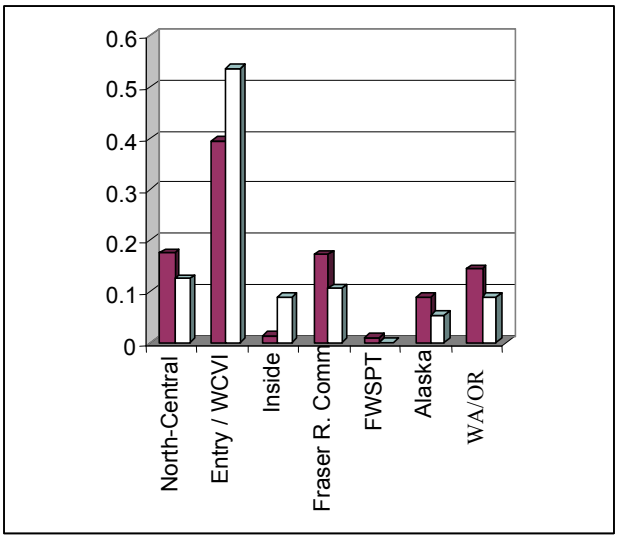


Fig. 5. Distribution of estimated CWT recoveries of upper Fraser summer-run chinook before (n=506), and during or after (n=49), 1997.

No North Thompson basin summer chinook CWTs have been recovered since 1996. Up to and including 1996, there were an estimated 3,400 recoveries of tagged North Thompson chinook, from the Raft, Clearwater and the North Thompson River itself. Recoveries were most common in the WCVI/Entry and in north-central area fisheries.

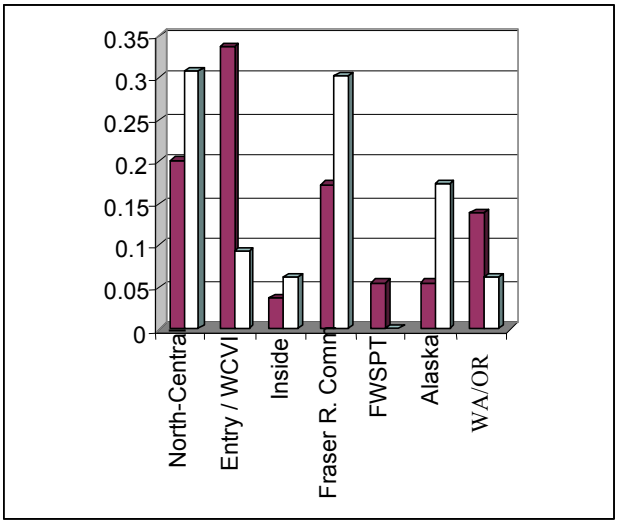


Fig. 6. Distribution of estimated CWT recoveries of mid-Fraser summer-run chinook before (n=2150), and during or after (n=195), 1997.

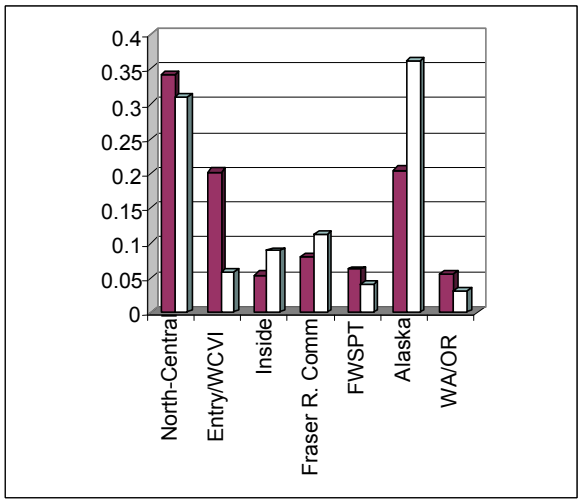


Fig. 7. Distribution of estimated CWT recoveries of South Thompson summer run chinook before (n=9914), and during or after (n=472), 1997.

South Thompson summer chinook appeared to have a more northerly marine catch distribution than other Fraser summer-run populations (Fig. 7). A large proportion of South Thompson-origin summer chinook were recovered in the northern waters of B.C. and in the Alaskan fisheries. Most freshwater sport recoveries occurred in the terminal sport fisheries on the lower and mid-Shuswap River.

Fall-Run Lower Fraser Chinook

To understand the distribution of Harrison chinook in the marine fisheries, we utilized information from chinook tagged and released from the Chehalis River Hatchery. It is not practicable to tag adequate numbers of naturally produced juvenile chinook leaving the Harrison River due to their small size. Since 1981, Harrison chinook have been enhanced at this hatchery, which is located on a tributary of the lower Harrison River.

Harrison-origin (Chehalis) chinook salmon were predominantly coastal in their marine distribution. Most recoveries occurred in southern fisheries in the WCVI/Entry area, the Strait of Georgia, and Washington waters (Fig. 8).

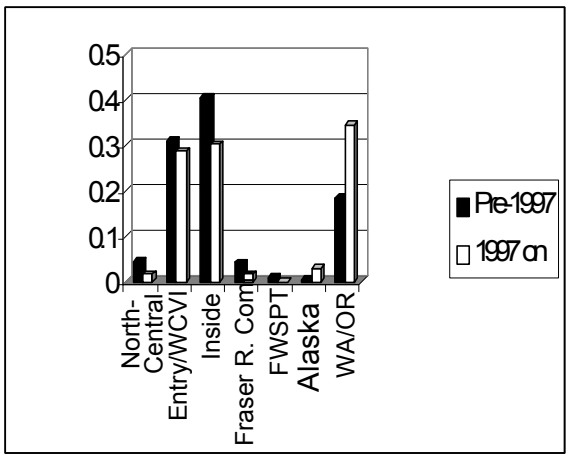


Fig. 8. Distribution of estimated CWT recoveries for Harrison (Chehalis) fall-run chinook before (n=24166), and during or after (n=544), 1997.

Resource Status

Many of our inferences about the status of Fraser drainage chinook are based on spawner escapement data. Most data are from visual surveys, which are generally biased to low counts although they are considered reasonably precise. Counting fences and mark-recapture projects occur for some systems, although are rarely last long enough to examine time series of escapements.

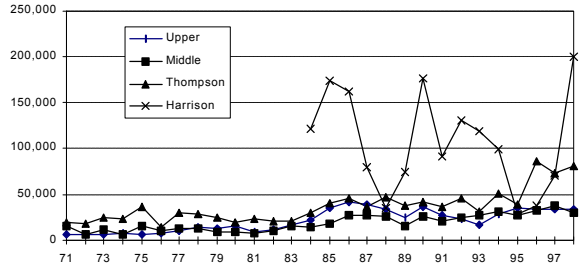
Included in the upper Fraser complex are approximately 16 stream populations that spawn in the Fraser River and its tributaries upstream of Prince George, including fish from the McGregor, Nechako, Stuart, and Torpy River systems. In most recent years, mark-recapture estimates have been produced for the Stuart River, area-under-the-curve estimates for the Nechako, and fence counts for the Salmon River (Prince George). In the mid-Fraser complex are 12 populations downstream of Prince George, including fish from the Chilko, Chilcotin, and Quesnel River systems. In both complexes, estimates are generated primarily from aerial overflight data and by dividing the peak count by 0.65.

Within the Thompson are fish spawning in tributaries to the lower Thompson River downstream of Kamloops (Deadman River and Nicola River systems), 6 tributaries to the North Thompson plus the North Thompson itself, and 7 tributaries to the South Thompson, including the lower and middle Shuswap, and the South Thompson. Most escapement estimates are produced by expanding peak visual survey estimates, but counting fences or fishways are utilized in the Eagle, Salmon, Bonaparte, and Deadman Rivers. The Nicola River is the site of a cooperative enumeration project with the local First Nations.

The Harrison River population (lower Fraser) has been consistently enumerated by a mark-recapture project since 1984. Chinook escapements to the Harrison were also estimated from 1951 to 1986 by visual surveys. Unfortunately these estimates were largely subjective and visual estimates in the latter years were influenced by the ongoing mark-recapture programme. It has therefore not been possible to adequately reconstruct the Harrison time series prior to 1984.

The Fraser escapement time series is numerically dominated by the Harrison (Fig. 9). Returns to the Harrison have been highly variable and without any overall trend. Non-Harrison stock aggregates increased in numbers commencing in the mid-1980s. Since 1995, escapements of the Thompson aggregate appear to have increased more than did upper and mid-Fraser populations, likely due to coho conservation measures and declines in late sockeye fisheries.

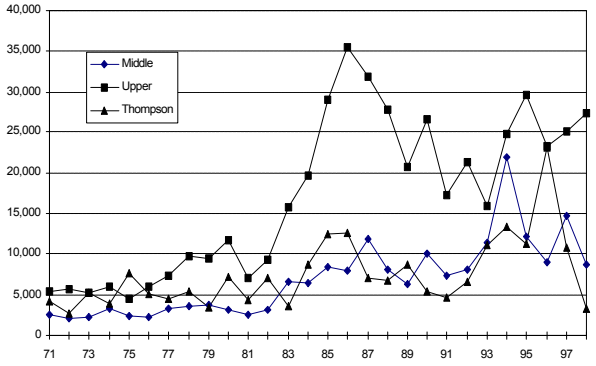
Fig. 9. Estimated numbers of chinook salmon returning to major areas of the Fraser River watershed



An examination of the non-Harrison data separated into the major timing groups is more informative. While all early returning aggregates appeared to increase numerically in the mid-1980s, the increase was largest in the upper Fraser (Fig. 10). Early timed runs to the Thompson have

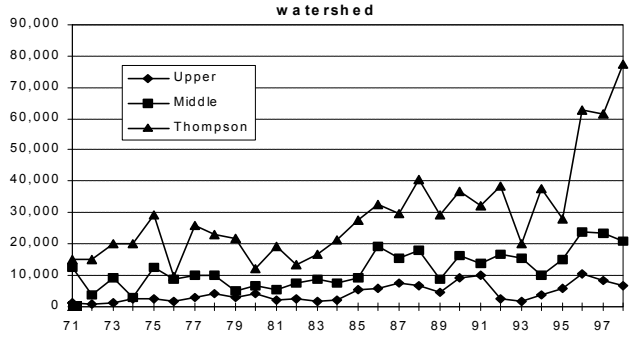
been trending downwards in the most recent years, while early runs to the upper and mid-Fraser, while highly variable, have been without a pattern.

Fig. 10. Estimated numbers of spring-run chinook returning to major areas of the Fraser River watershed



Summer aggregates also increased numerically in the mid 1980s (Fig. 11). Summer runs to the Thompson have apparently been doing well the last several years while escapements for other summer stock aggregates have been relatively unchanged.

Fig. 11. Estimated numbers of summer-run chinook returning to major areas of the Fraser River watershed



Outlook

Forecasts of the next year's escapement for wild spawning Harrison chinook are made annually and a forecast methodology for Harrison-origin chinook spawning in the Chilliwack River is under development. As part of the mark-recapture escapement estimation programme at the Harrison, estimates of spawner escapements are partitioned by age class. "Sibling regression" uses the numbers of younger spawners in one year to predict the numbers of older spawners in subsequent years. This method requires that fishery exploitation rates remain constant over time. The method has worked well in most years, but significantly underestimated the returns in 1998, when exploitation rates were much lower than average. The forecast for 1999 is for about 85,000 spawners in the Harrison (jacks excluded) which is about 80 % of the average escapement during the last 15 years. As well, the numbers of females returning in 1999 may be low.

The longer term prognosis for fall-returning white chinook is uncertain. Escapements of enhanced Harrison origin fish to the Chilliwack River have generally increased since the population was established, and in 1995 and 1997 they were estimated to exceed the numbers of naturally spawning chinook in the Harrison. Within the Harrison River, all chinook spawn in a 16.5-km stretch of river downstream from Harrison Lake. The fry emigrate downstream shortly after emergence and use side channels and sloughs of the lower Fraser River and its estuary as their predominant rearing locations. The Harrison River is used for log transport and storage and the lower Fraser River and estuary is affected in numerous ways by the city of Vancouver. The wild population is clearly vulnerable to degradation of these important habitats.

Quantitative forecasts are not made for spring and summer timed stock aggregates. To provide forecasts, better annual sampling for age structures, more quantitative estimates of spawning escapements, and improved in-river catch information separated by population and age are required. For spring populations (Fig. 10), recent spawning escapements have been generally higher than during the 1970s but the recent trend in the aggregate escapement index has been downwards. Researchers are concerned about the status of this group, especially the earliest components of the run, including the Spius Creek, Coldwater River, Birkenhead River, and the Upper Chilcotin River populations. Escapements of the summer stock aggregate (Fig. 11) have generally been up the last 3 years although there has been significant variability amongst streams. Escapements of mid and upper Fraser summer

stock aggregates have often been down in recent years, while returns of late timed South Thompson populations are strong.

It is clear that upriver chinook populations have benefited from reductions in ocean harvests. Canadian marine fishery exploitations were significantly reduced in 1985 in accordance with the rebuilding programme under the Pacific Salmon Treaty and all non-Harrison stock aggregates appeared to increase (Figs. 9-11). Recent fishery reductions, designed in part to conserve upriver populations of Fraser coho and sockeye, have also benefited many Fraser chinook populations, especially summer runs of chinook in the Thompson. In-river harvests of early-run chinook may have delayed their rebuilding.

The long-term prognosis of upriver stocks of Fraser chinook is uncertain. It is not clear whether the freshwater carrying capacity for these populations has been achieved. Freshwater habitat degradation is a concern in some watersheds. Meanwhile, interim escapement goals, established for all major Fraser chinook stock aggregates about 15 years ago, are currently being reviewed. Many upriver populations are well above these goals, which may have been too conservative, while the Harrison River population has never reached its target. Researchers plan to use habitat-based approaches for upriver populations while a stock-recruit approach will be used for the Harrison to establish new target escapements.

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