A Review of the Chinook and Coho Salmon of the Fraser River

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Fraser River chinook (Oncorhynchus tshawytscha) and coho (O. kisutch) have undergone a decline in total return to the home river since the 1950's, attributed mainly to overfishing and habitat degradation. This report summarizes the status of the Fraser River chinook and coho: reviews their life history, gives records and trends in escapements of individual stocks and in catches by various fisheries, and highlights the extent of human degradation of the river.

Key words: Fraser River, chinook, coho, salmon, life history, catch, escapement, fisheries.

RÉSUMÉ

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. 1126:130p.

Depuis 1950, la détérioration du nombre de saumons quinnat (Oncorhynchus tshawytscha) et coho (O. kisutch) qui retournent au fleuve Fraser est due principalement à la dégradation de l'habitat et à la sur-exploitation de la pêche. On a inclus dans cette revue des saumons quinnat et coho du fleuve Fraser, le cycle vital des espèces, les nombres pris en pêcheries, l'échappement de chaque stock et un profil de la dégradation humaine du fleuve.

Mots-clés: le fleuve Fraser, saumon, quinnat, coho, cycle vital, prise, échappement, pêcheries.

INTRODUCTION

The Fraser River, the largest river in British Columbia in length, drainage area, and total discharge, supports major populations of all five species of Pacific salmon: sockeye (Oncorhynchus nerka), chum (O. keta), pink (O. gorbuscha), chinook (O. tshawytscha), and coho (O. kisutch); and two species of anadromous trout: steelhead (Salmo gairdneri) and cutthroat (S. clarki). Milne (1964) estimated that about one-third of the total historical chinook catch in B.C. was of Fraser River origin, although this proportion has probably declined due to massive releases of hatchery produced chinook juveniles since the early 1970's, especially from facilities in the United States.

This report provides the first complete overview of the status of the Fraser River chinook and coho salmon with regard to their life history, historical catch contributions (1951 - 1980) to various fisheries, and trends in escapement, as well as a general summary of environmental degradation affecting rearing and spawning grounds. It is hoped that this review will increase awareness of the importance and complexity of these two salmon species in the Fraser River, and facilitate the development of appropriate management strategies.

FRASER RIVER WATERSHED

The Fraser River drainage area occupies approximately 230,000 km^2 or most of the southern half of British Columbia (Fig. 1). This river originates on the western slopes of the Rocky Mountains and flows for 450 km in a northwesterly direction through the Rocky Mountain Trench to beyond the northern end of the Columbia Mountains. It then flows southward for 750 km through the Interior Plateau, then through the Coast Mountains. At Hope, the Fraser River turns west and flows seaward for 150 km, passing through a broad alluvial valley flanked by the Coast Mountains on the north and the Cascade Mountains on the south. In these 150 km, the elevation of the Fraser River drops approximately 40 m, 30 m of which occurs in the first 70 km (Fraser River Board 1963). The river channel from Hope to outlet has an average width of 600 m, but during freshet can swell to more than 5 km in some areas.

Downstream at New Westminster, the Fraser River divides into two major branches: the North Arm and the Main or South Arm (Fig. 2). The Main Arm draws off about 80% of the total flow at this point (Luternauer 1974). Divisions occur in both the North and Main Arms, with the largest division into North and Middle Arms occurring around Sea Island (Fig. 2).

Several major tributaries join the Fraser River. The Salmon River, the Stuart-Trembleur Lake system and the Nechako River system in the north drain the north Interior Plateau and the Coast Mountains, while the McGregor River drains the western slopes of the Rockies; the Chilko-Chilcotin system in the west, and the Harrison, Stave and Pitt Rivers in the south, drain the Coast Mountains; and the Quesnel and Thompson Rivers in the east drain the Columbia Mountains (Fraser River Board 1963). The largest lakes in the Fraser River system include the Stuart, Takla, Trembleur, Nechako Reservoir, Francois, Quesnel, Chilko, Shuswap, Harrison, Stave and Pitt (Fig. 1). Their combined surface area is over 3000 km^2 (Fraser River Board 1963).

The various mountain ranges form major physiographic land divisions in

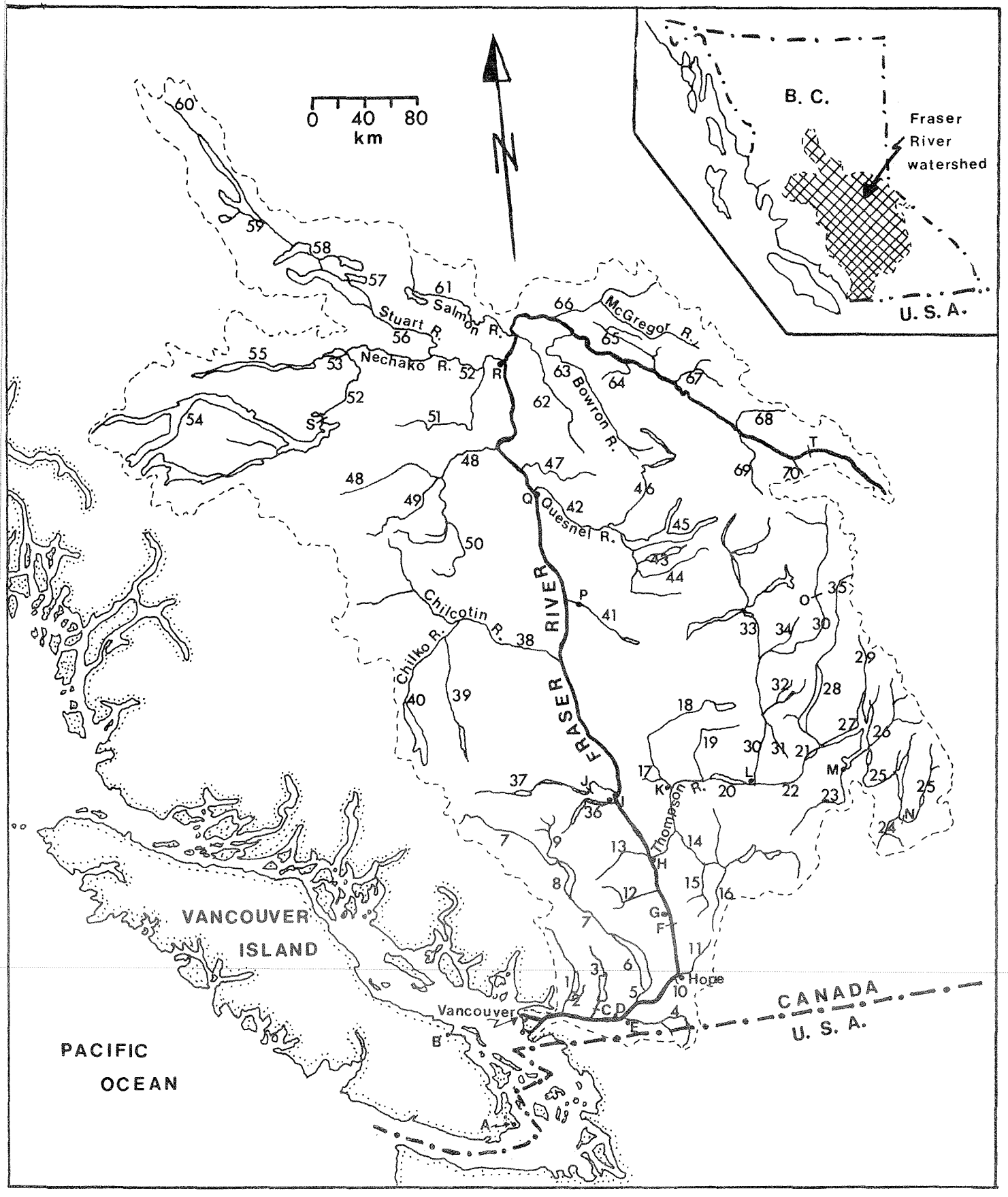


Fig. 1. Fraser River watershed showing major tributaries, towns and obstructions (numbers and letters are arranged consecutively, South to North).

LEGEND (in alphabetical order)

Fraser River Watershed

RIVERS, LAKES

28. Adams L.
35. Adams R.
2. Alouette R.
49. Baezaeko R.
24. Barriere R.
32. Bessette Cr.
9. Birkenhead R.
18. Bonaparte R.
63. Bowron R.
37. Bridge R. and Carpenter L.
46. Cariboo R.
51. Chilako R.
38. Chilcotin R.
40. Chilko R. and Chilko L.
4. Chilliwack R.
33. Clearwater R.
16. Coldwater R.
11. Coquihalla R.
47. Cottonwood R.
20. Deadman R.
60. Driftwood R.
26. Eagle R.
55. Francois L.
6. Harrison L.
5. Harrison R.
18. Hat Cr.
68. Holmes R.
43. Horsefly L.
44. Horsefly R.
10. Jones Cr.
20. Kamloops L.
8. Lillooet L.
7. Lillooet R.
21. Little Shuswap L.
31. Louis Cr.
66. McGregor R.
70. McLennan R.
59. Middle R. and Takla L.
67. Morkill R.
12. Nahatlatch R.
50. Nazko R.
54. Nechako Reservoir
52. Nechako R.
14. Nicola R.
30. North Thompson R.
1. Pitt R. and Pitt L.
45. Quesnel L.
42. Quesnel R.
69. Raush R.
34. Raft R.
23. Salmon R.
61. Salmon R.
41. San Jose R. and Lac la Hache
36. Seton R. and Seton-Anderson L.
29. Seymour R.
27. Shuswap L.
25. Shuswap R.
64. Slim Cr.
22. South Thompson R.
15. Spius Cr.
3. Stave L. and Stave R.
13. Stein R.
53. Stellako R. and Fraser L.
57. Stuart L.
56. Stuart R.
58. Tachie R. and Trembleur L.
39. Taseko R. and Taseko L.
65. Torpy R.
48. West Road R.
62. Willow R.

TOWNS, OBSTRUCTIONS

K. Ashcroft
G. Boston Bar
J. Bridge River Dam
E. Chilliwack
F. Hell's Gate
L. Kamloops
S. Kenney Dam
I. Lillooet
H. Lytton
D. Mission
B. Nanaimo
O. Porte d'Enfer Canyon
R. Prince George
Q. Quesnel
T. Rearguard Falls
M. Salmon Arm
N. Shuswap River Dam
C. Stave River Dam
A. Victoria
P. Williams Lake

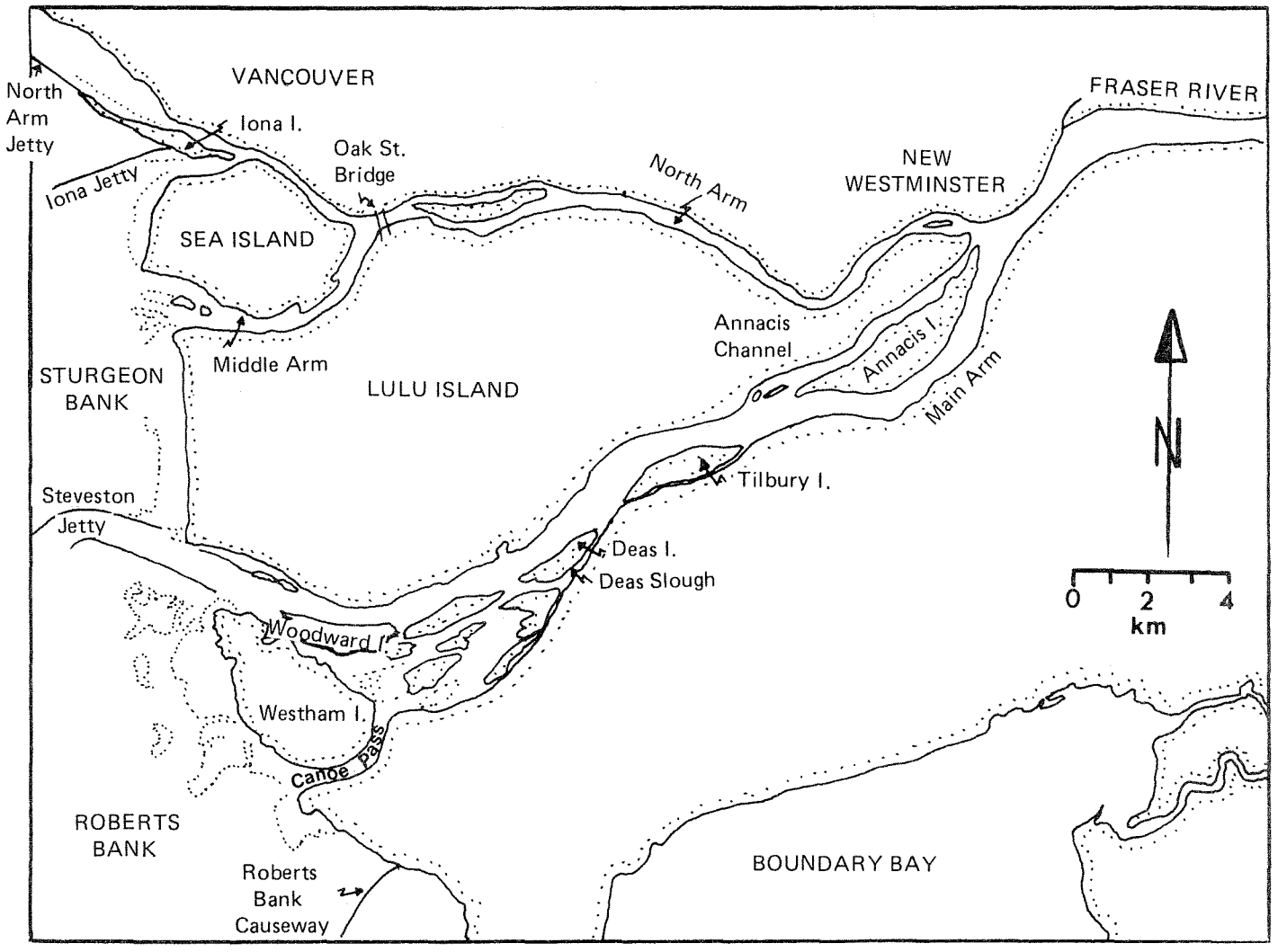


Fig. 2. Lower Fraser River below New Westminster.

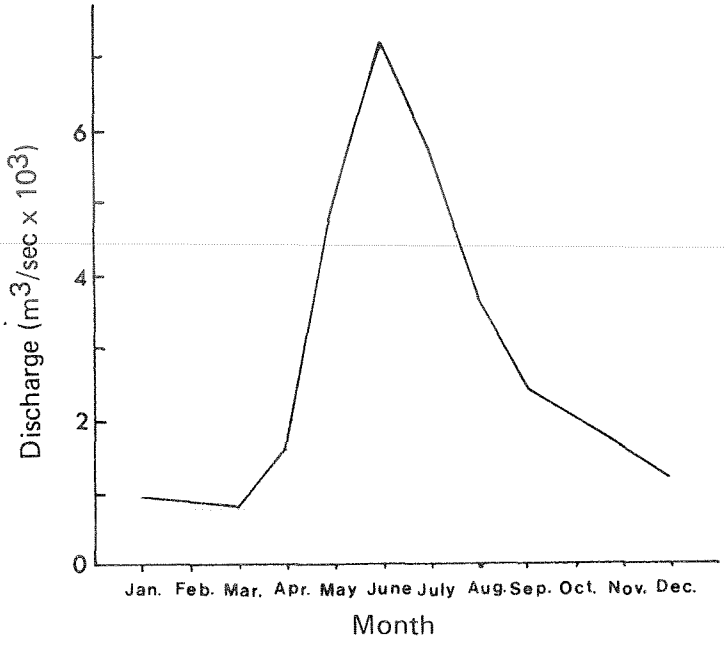


Fig. 3. Mean monthly discharge in the Fraser River at Hope, 1913–1976.

the Fraser River basin and dictate the climatic zones. The annual precipitation in the Fraser River basin varies from over 150 cm in some of the mountainous regions to less than 50 cm in most of the Interior Plateau. The region around Kamloops Lake and Ashcroft (Fig. 1) is one of the driest in Canada, averaging less than 20 cm precipitation per year. The mean annual rainfall for the entire basin above Hope is approximately 80 cm, of which about two-thirds falls as snow (Fraser River Board 1958). The proportion of snow is much lower downstream from Hope. Depending on land topography, moderate to extreme temperature regimes are also encountered; for example, extreme winter temperatures as low as -47° C are recorded in the Quesnel area, and extreme summer temperatures as high as 41° C are recorded in the central Interior Plateau (Env. Canada, 1941-1970 data).

The mean annual discharge of Fraser River at Hope is 2,740 m^3/sec (1913 - 1976; Water Survey of Canada 1977). Peak monthly flow normally occurs in June; lowest monthly flow occurs in March (Fig. 3). The maximum daily flow for the period of record was 15,200 m^3/sec, recorded in 1948. The minimum daily flow was 340 m^3/sec recorded at Hope (January, 1916) and 725 m^3/sec recorded at Mission (December, 1972). The mean annual discharge downstream at Mission and below the confluence with Harrison River is 3,570 m^3/sec (1966 - 1976), with a maximum flow of 17,500 m^3/sec estimated from high water marks made there during the great flood of 1894 (Fraser River Board 1958).

Tidal effects are usually apparent to Mission (75 km from the outlet) but can extend as far as Chilliwack (100 km from the outlet).

During periods of freshet, the river has a high turbidity with a suspended solid load of up to 389 mg/l (Northcote 1974). The annual sediment load discharged past Port Mann (Fig. 10) has averaged 18.0 million metric tonnes during 1967 to 1972 but has varied from 10.9 million metric tonnes in 1970 to 26.3 million metric tonnes in 1969 and 1972 (Luternauer 1974). Much of the annual load is dispersed by means of the delta's distributory system during May, June and July, and there can be extensive river bed alteration because of rapid silt deposition and scouring. The sediment itself is almost all sand and consists of 40% quartz, 11% feldspar, 45% unstable rock fragments and 4% miscellaneous particles (Luternauer 1974). The intertidal area associated with the Fraser River delta (Sturgeon and Roberts Banks, Fig. 2), comprises approximately 157 km^2. The average annual sedimentation rate on these tidal flats has been 0.42 mm, but the rate is not uniform as some sections are retreating while others are advancing (Hoos and Packman 1974).

The Fraser River flow is affected significantly by a partial obstruction located at Hell's Gate, 200 km upstream from the mouth (Fig. 1), formed by two rock spurs which create cross-currents and turbulence patterns that block fish passage. The degree of obstruction depends on the amount of river flow, but some blockage occurs at nearly all water levels normally encountered during salmon migration (Jackson 1950). Although evidence for the obstruction of fish passage is limited largely to sockeye salmon, both coho and even the much larger chinook are likely to be affected as well.

The circumstances leading up to the Hell's Gate obstruction serve as a classic example of how carelessness toward a sensitive environment can lead to serious and permanent damage. During the building of the Canadian Northern Railroad in the winter of 1912 to 1913, rocks from excavations were dumped into the Fraser River, raising the head in the vicinity of the "Gate" to 1.5 m over a very short distance (Jackson 1950). As a result, salmon passage was

seriously impeded. For example, sockeye escapement to the Quesnel system declined from 4,000,000 in 1909 to 532,000 in 1913, to 26,000 in 1917 (Rounsefell and Kelez 1938). During the winter of 1913 to 1914, a slide resulting from continued railroad construction dropped an estimated 75,000 m^3 of granite blocks directly into the river above the "Gate's" narrowest portion. The river was thus further narrowed to 23 m, and a drop of 4.6 m was formed over a distance of 25 m (Jackson 1950). This obstruction was eventually cleared and the drop reduced to 2.7 m over 100 m distance. But it wasn't until 1945 that fishways were constructed along both sides of the obstruction, allowing free passage of salmon at all water levels normally expected during fish migration (Talbot 1950).

The remainder of the upstream section of the Fraser River is passable to salmon up to Rearguard Falls, 1,350 km from the outlet (Fig. 1), although recent surveys revealed small numbers of chinook spawning above this obstruction. Other points of difficult salmon passage are located at Scuzzy Rapids and China Bar between Hell's Gate and Hope; at Bridge River Rapids just upstream of the confluence with Bridge River near Lillooet; at Porte d'Enfer Rapids in North Thompson River; and in the Bonaparte, Horsefly and Clearwater Rivers (Fig. 1). At present, six fishways operate at the Hell's Gate, four at Yale Rapids (20 km above Hope), two at the Bridge River Rapids, and five at Farwell Canyon on Chilko River (Fig. 1).

LIFE HISTORY

CHINOOK

Incubation

Incubation can be divided into two periods, the first lasting from fertilization to hatching, and the second (alevin stage) lasting from hatching to yolk sac absorption and emergence from gravel. The length of both periods is governed by ambient temperatures, and the rate of development can vary from 0.2% to over 3% by weight per day (Alderdice and Velsen 1978). Incubating chinook eggs usually require approximately 500 degree-days (^{o}C) before hatching (one day at $1^{o}C$ provides one degree-day), and a total of 1,000 degree-days before emergence from gravel (Department of Fisheries and Oceans (DFO), unpublished data). Chinook fry emergence in rivers studied in B.C., Washington and Idaho usually occurs in the spring between March and June (Schmidt et al. 1979). Spring surveys on the Fraser River spawning grounds in 1979 showed the following peak emergence dates for selected up-river chinook stocks: Nicola River - April 26; Shuswap River -April 29; Chilko River - May 15; and upper Fraser River - May 26 (DFO, unpublished data).

Dispersal and rearing of chinook juveniles

Upon emergence from gravel, chinook fry migrate passively downstream, primarily at night (Mattson 1962; Reimers 1968, 1973; Lister and Genoe 1970). Some chinook may also migrate eventually into upstream rearing areas, as in Swansen and Twin Creeks of the Nechako River (R. Murray, pers. comm.) and in Slim Creek of the upper Fraser River (R. Russell, DFO, pers. comm.). This dispersal behaviour increases utilization of available rearing areas and also occurs among stream-rearing coho and steelhead, and lake-rearing sockeye (Chapman 1966).

Chinook fry, after their initial downstream dispersal, may follow one of three major life history patterns, based on length of the freshwater rearing period. These patterns are: I - the "immediate" fry migrants that move toward an estuary directly after emergence; II - the "ocean-type" migrants that have a limited freshwater phase of some 60 to 150 days; and III - the "stream-type" migrants that have an extended freshwater phase of up to a year or more. In the following discussion on the life history of young salmon, the following terms are used: fry - young salmon newly emerged from gravel; juveniles and fingerlings -older fish prior to smolt transformation; smolts - juveniles which have lost their parr marks and are undertaking their migratory journey to the sea.

I. "Immediate" fry migrants: In coastal streams, many newly emerged chinook fry migrate directly to the estuary or the ocean, for example: in the Willamette River (Mattson 1962), Cowichan River (Lister et al. 1971), Big Qualicum River (Lister and Walker 1966), Nanaimo River (Healey 1980), and Fraser River (DFO, unpublished data). Hoar (1976) observed that "in its gradual acquisition of high salinity tolerance and its capacity for rapid acclimation, the chinook is distinctly different from other salmonids"; also, unlike coho, sockeye, and steelhead, but like pink and chum salmon, chinook fry can tolerate high salinities shortly after emergence.

In general, "immediate" chinook fry migrants appear to originate primarily from late-run or "fall" chinook stocks (K. Pitre, DFO, pers. comm.). Limited data on the "immediate" chinook fry migrants in the Fraser River are provided by a juvenile enumeration program conducted at Mission (Fig. 1) each spring and designed primarily to estimate the annual abundance of migrating Fraser River chum and pink fry (DFO, unpublished data). The estimated number of chinook fry migrating past Mission averages over 40 million fish per year and probably represents a substantial portion of the total Fraser River chinook fry production, with the Harrison River probably the major contributor as indicated by migration timing estimates. Chinook fry migrate past Mission from mid-March to mid-May with mean peak and 50% migration dates both occurring around mid-April (range: March 24 to May 11) (Table 1). The migration timing of the Harrison River fry (March to mid-May) (IPSFC, unpublished data) fits well with the timing at Mission.

While the exact proportion of the Fraser River chinook fry that are "immediate" migrants is unknown, there is some evidence that in a given population this fraction is directly related to the size of the receiving estuary. Rivers with well developed estuaries, such as the Cowichan River (Fig. 9), have a larger proportion of "immediate" fry migrants, compared to rivers with small estuaries, such as the Big Qualicum River on Vancouver Island (Fig. 9, Table 2). This may explain why Reimers (1973) and Schluchter and Lichatowich (1977) downgraded the importance of "immediate" seaward migrants in the Sixes and Rogue Rivers respectively, both of which have relatively small estuaries.

II. "Ocean-type" fry migrants: "Ocean-type" migrants (Gilbert 1913; Mason 1965; Major et al. 1978) rear in freshwater from about 60 to 150 days, before migrating seaward as smolts. Examination of scales from returning adults indicates that this is the dominant life history pattern among the eastern Pacific chinook (Rich 1925; Lister and Walker 1966; Reimers 1973; Schluchter and Lichatowich 1977). Likewise in the Fraser River, up to 90% of both the red- and white- fleshed adult chinook aged in the terminal net fishery, were classified as "ocean-type" fish (Table 3). However, these may

Table 1. Migration timing of chinook fry estimated at Mission Bridge, 1970-1979.[a]

Migration year	Peak migration date	50% Migration date
1970	April 2	April 8
1971	April 28	May 4
1972	May 5	May 7
1973	May 4	April 29
1974	May 3	April 15
1975	April 4	April 17
1976	April 8	April 20
1977	March 24	March 28
1978	May 8	April 23
1979	May 11	May 10
Mean	April 22	April 22

[a] DFO (unpublished data).

Table 2. Comparison of the numbers of "immediate" chinook fry migrants with 90-day "ocean-type" migrants in two east coast Vancouver Island streams.

River	Migration year	No. of "immediate" migrants ($\times 10^3$)	No. of 90-day migrants ($\times 10^3$)	Ratio: "immediate"/ 90-day migrants
Cowichan R.[a]	1966	2519	91	27.7 : 1
	1967	1351	227	6.0 : 1
Big Qualicum R.[b]	1965-1978 (mean)	99	60	1.7 : 1

[a] Lister, Walker, and Giles (1971).
[b] Perry, Bailey, and Fraser (MS 1978).

Table 3. Percent occurrence of "ocean-and stream-type" life histories among red and white chinook stocks from Fraser River gillnet fishery, 1957-1978 (n gives sample size).[a]

	Red chinook			White chinook		
Years	% "ocean-type"	% "stream-type"	n	% "ocean-type"	% "stream-type"	n
1957-1959	42	58	544	76	24	433
1964-1969	51	49	10,214	70	30	4,588
1975-1978	86	14	2,595	92	8	808

[a] Determined by scale reading; Append. 2 lists data sources.

also include those chinook that rear exclusively in the estuary, because the initial circuli laid down by the latter fish may resemble freshwater growth.

The Fraser River "ocean-type" migrants probably rear in freshwater from 60 to 150 days, depending on their tributary of origin, before migrating to the ocean during June to September. Beach seining in 1971 and 1976 in Little Shuswap Lake and in the South Thompson River (Fig. 1), a major Fraser River chinook production area, revealed a considerable number of migrating "ocean-type" chinook smolts during July and August (DFO, unpublished data). This relatively late migration timing, compared to timing in other eastern Pacific rivers (Schmidt et al. 1979), is due largely to later emergence of fry in the Fraser River where lower water incubation temperatures lead to relatively slower development rates of fish embryos.

During their limited freshwater rearing phase, the majority of "ocean-type" juveniles may take up residence in back eddies along the main river course, as in the Sixes River (Reimers 1973). Lister and Genoe (1970) showed that as chinook juveniles in the Big Qualicum River grew in size, they occupied stream habitats with increasing velocity and depth. Chapman and Bjornn (1969) related this change in habitat preference to the search for areas with increased food abundance. Such a shift in habitat also serves to segregate spatially chinook juveniles from potentially competitive coho (Lister and Genoe (1970) and steelhead (Everest and Chapman 1972) juveniles; coho and steelhead juveniles have different sizes at any given time compared to chinook due to their considerably different adult spawning timing. At this stage of their development, juvenile chinook feed primarily on stream insect fauna, particularly the floating or swimming Diptera (Becker 1973).

III. "Stream-type" fry migrants: Chinook juveniles which remain in freshwater for an entire winter and migrate to the sea in their second spring, are commonly referred to as the "stream-type" chinook (Gilbert 1913; Mason 1965; Major et al. 1978). Such fish are usually considerably less common than the "ocean-type" chinook. River systems in which chinook tend to overwinter are generally more northerly in location, such as the Taku River in northern B.C. (Meehan and Siniff 1962); or are more distant from the sea, such as the upper tributaries of the Columbia River (Rich 1925) and some upper Fraser River tributaries (Tutty and Yole 1978); or have early spring runs, such as the Willamette River (Mattson 1963).

Among the Fraser River chinook, the "stream-type" life history pattern is less common than the "ocean-type" pattern, as indicated by scale data from returning adults, and is more prevalent among the red-fleshed chinook (up to 58% of fish sampled during 1957 to 1959) compared to white-fleshed fish (up to 30% of fish sampled during 1964 to 1969) (Table 3). A considerable decline in the proportion of the "stream-type" compared to the "ocean-type" red-fleshed chinook has been observed since the late 1950's (down from 58% to 14%, Table 3), but more recent scale data indicate an increase to former levels (DFO, 1980 and 1981 preliminary data).

Many "stream-type" chinook possibly overwinter in the mainstem of the larger rivers, including the Fraser River. Peak seaward migration of "stream-type", year-old smolts probably occurs in the lower Fraser River during May (DFO, unpublished data).

Estuarine rearing of chinook juveniles

Estuary is defined here as that body of water located in and seaward of a river mouth and subjected to a continuous influence of freshwater outflow. While the proportion of the Fraser River chinook rearing in the estuary, and the contribution of this group to the total adult return is unknown, evidence suggests that estuarine rearing is important in the life history of most chinook stocks. Reimers (1973) identified among juveniles from Sixes River, Oregon, periods of estuarine rearing that ranged from a few days to several months. He suggested tht fish having a lengthier period of estuarine residence may also have higher smolt-to-adult survival rates, particularly if they had previously reared 60 to 90 days in freshwater. In agreement with the above hypothesis, those rivers on the B.C. coast with well developed estuaries, such as the Fraser, Skeena and Cowichan Rivers, are the major wild chinook producers.

Levy et al. (1979) conducted mark-recapture experiments in the inner Fraser River estuary around Woodward Island (Fig. 2) and found that locally captured 0+ chinook ("immediate" fry migrants) reside there from three to six weeks, compared to only several days to two weeks for pink and chum fry, and that chinook outnumbered the two latter species in May and June. By early June, chinook juveniles reached a mean fork length of over 63 mm which is similar to the size of "ocean-type" migrants, as indicated in the Big Qualicum River study (Lister and Genoe 1970); by the end of June they disappeared almost completely from the estuarine catches, presumably migrating away from the shore into Georgia Strait (levy et al. 1979).

Purse seining in 1971 on Roberts and Sturgeon Banks off the Fraser River mouth (Fig. 2), revealed a considerable number of 0+ chinook juveniles starting in late April, as well as yearling (1+) chinook and coho smolts (DFO, unpublished data). During August and September, the mean size of juvenile chinook in that area declined. This may be due to an influx of smaller (relative to resident population) 0+ chinook smolts, indicating the arrival of up-river "ocean-type" migrants.

Ocean rearing of chinook

The oceanic distribution of various chinook stocks has been studied since the 1920's by tagging adults in mixed stock fisheries at sea, usually with external tags, or by removing selected fins, then recovering the marks from various fisheries or on spawning grounds (Mottley 1929; Milne 1957). More recently, since the early 1970's, coded wire nose tagging (CWT) (Jefferts et al. 1963), combined with adipose fin clipping of salmon juveniles captured near the site of their origin, and subsequent retrieval of marked adults, has become a common method for studying oceanic distribution, survival and migration timing of distinct stocks. Earlier data, prior to the CWT program, are considered to be less reliable than the CWT data, due to possible fin regeneration and increased fish mortality (Cleaver 1967). Unfortunately, both external and coded wire tagging methods have serious statistical biases due to variable intensity of both marking effort and recovery, making it difficult to use the data for stock population estimates, especially when the number of recovered tags is small.

At present, the fate of Fraser River chinook juveniles after they leave the estuary is not completely understood. Significant numbers probably remain in Georgia Strait to rear to maturity, as suggested by substantial local sport

and commercial troll fisheries based on resident stocks, with the Fraser River probably a major contributor (Argue et al. 1982). A portion of the Fraser River chinook juveniles migrates out of Georgia Strait in a northwesterly direction through Johnstone Strait. The northwesterly direction is apparently a dominant migratory route for all eastern Pacific stocks (Mason 1965; Major et al. 1978). It is likely that rearing stocks in the eastern Pacific Ocean remain relatively close to shore because of the rich feeding grounds off the continental shelf. This is confirmed by the highly productive troll fishery off the B.C. and Alaskan coasts, capturing primarily immature, feeding chinook (Major et al. 1978). The mid-Pacific chinook catches recorded by the Japanese fishery are probably derived from Asian and western Alaskan stocks, as well as from the Yukon River (Major et al. 1978).

Chinook mark recaptures from 1925 to 1971 (Table 4) indicate returns to the Fraser River of adults tagged off the west coast of Vancouver Island and off the central coast of B.C. Petersen disc tagging in Alaska by Parker and Kirkness (1951, 1956) showed that substantial numbers of Fraser River chinook were feeding in the outer waters of southeastern Alaska (Table 4). Preliminary returns from coded wire tagging of the South Thompson River chinook juveniles (1975 brood) also indicate significant adult returns from southeastern Alaska (Table 13).

Chinook adult migration timing

Approximately 65 tributaries of the Fraser River support chinook salmon, but the racial timing of chinook through the lower Fraser River terminal commercial fishery is, as yet, not clearly identified. Past tagging studies on returning chinook have been very few and the returns negligible. However, many of the more important stocks are currently being nose tagged and the return of these as adults will provide much valuable information on specific racial migration timing.

A rough estimate of timing in the lower portions of the Fraser River may be obtained by backdating from the arrival on spawning grounds. However, this method is subject to considerable error because the arrival of spawners on the spawning grounds often encompasses a three to five week period which is not accurately reported, and the precise rate of travel by chinook in the Fraser River is estimated only crudely at this time at 20 km to 30 km per day (Append. 1).

In addition to backdating, other information on the migration of specific Fraser River stocks is available. For example, chinook from the Birkenhead River (about 300 km from the Fraser River mouth) supported, until recently, a small sport fishery on that river and on upper Lillooet Lake in late April to early May (DFO, unpublished data). This indicates that at least part of the Birkenhead stock enters the Fraser River very early in the season. In another case, a fishing strike during the last week of July and the first three weeks of August, 1975, was related to increased chinook escapements that year to the Chilko and Shuswap Rivers, thereby providing some information on migration timing of those stocks. Fishwheel studies near Prince George indicate that the most up-river chinook stocks pass through there during the last week of July (1961 data) and the second week of August (1962 data) (Chatwin et al. 1961, 1962). Using an estimated rate of travel of 20 km - 30 km per day, the 800 km trip from the mouth of the Fraser River to Prince George would require 25 to 40 days. This suggests that the far up-river stocks begin to enter the Fraser River fishery in early June, peaking from mid-June to early July. In

Table. 4. Recoveries in the Fraser River of chinook adults tagged with external tags in mixed-stock fisheries.[a]

Tagging location	Tagging years	References[b]	Total No. tagged	Total No. recovered	No. recoverd in Fraser River
Southeast Alaska					
Inside Waters	1950-1955.	A	3,098	202	1
Outside Waters	1950-1952.	A	918	157	19
North Central B.C.					
Dixon Ent. and Dundas Isl.	1956-'58,'66-'68.	A,B	421	94	3
Queen Charlottes	1925,'29,'30,'51.	A	1,999	269	51
Hecate St. and Browning Ent.	1930,'66-'68.	A,B	860	72	8
Johnstone St. and Queen Charlotte Strait	1928,'30,'63, '65,'70,'71.	A,B,C	921	57	6
Georgia Strait					
North of Parksville	1927,'63-'66.	A,B	805	153	13
South to Saanich (Canada)	1928,'63-'69,'70-'71.	A,B,C	5,730	781	45(+17)[c]
Northern Puget Sd. (US)	1962,'64.	A	1,708	583	189
Victoria and Area 20	1968-'69.	B	327	51	2
Sooke Traps	1952.	A	125	28	16
West Coast, Vancouver Isl.					
South (Area 21-23)	1925,'26,'49,'50, '69,'71.	A,D	7,436	1,308	47
North (Area 24-27)	1927,'49-'51,'69.	A,D	1,678	334	7
West Coast, United States					
Off Washington Coast	1949.	A	166	15	0
Off Oregon Coast	1948-'49.	A	198	11	0
Off California Coast	1939-'49.	A	6,144	484	0

[a] B.C. data are complete to 1974, but U.S. data are only representative up to 1964 (Godfrey 1968a).

[b] A-Godfrey(1968a);B-Argue and Heizer (1974); C-Heizer and Argue (1972); D-Bourque and Pitre (1972).

[c] Additional recoveries made just off the Fraser River estuary.

1969, Hollett and Armstrong (MS 1970) tagged chinook adults during the second week of August near Hope, about 180 km from the Fraser River mouth. The single spawning ground recovery from this study was made with a fishwheel on Clearwater River (600 km from the Fraser River mouth), indicating that this fish entered Fraser River approximately in the first week of August.

The estimated migration timing through the lower Fraser River fishery for most of the major Fraser River chinook stocks is shown in Figure 4. These estimates were derived from the above miscellaneous observations; by backdating from the time of arrival on spawning grounds using the rough migration rate of 20 km to 30 km per day; and by correlating the apparent abundance peaks in the terminal net fishery with the peaks on spawning grounds (see Fig. 19 and accompanying text for explanation).

Fraser River chinook may be grouped into early, middle and late timing stocks. The early timing stocks generally migrate through the lower Fraser River fishery from March to mid-July, with a major peak occurring in late June; these chinook are bound mostly for the up-river tributaries and contribute nearly 40% to the mean annual Fraser River chinook escapement (1976 - 1980 data, Append. 15a) (Fig. 4). The middle timing stocks generally migrate through the terminal fishery from late July to early September, peaking in August, depending on specific stock; these chinook are bound for the middle tributaries (mainly the Thompson River) and contribute some 35% to the mean annual escapement (1976 -1980 data, Append. 15d-f). Finally, the late timing Harrison River stocks generally arrive from early September to late October, peaking in late September, and contribute nearly 25% to the mean annual Fraser River escapement (1976 - 1980 data, Append. 15g).

In addition to migration timing distinctions, there are two distinct chinook groups based on flesh colour. These can also be segregated both to area of origin and to migration timing. The red-fleshed chinook enter the river during late spring and summer, and migrate to the upper tributaries; the majority of white-fleshed chinook enter later, in September and October, and head for the Harrison River (Godfrey 1975).

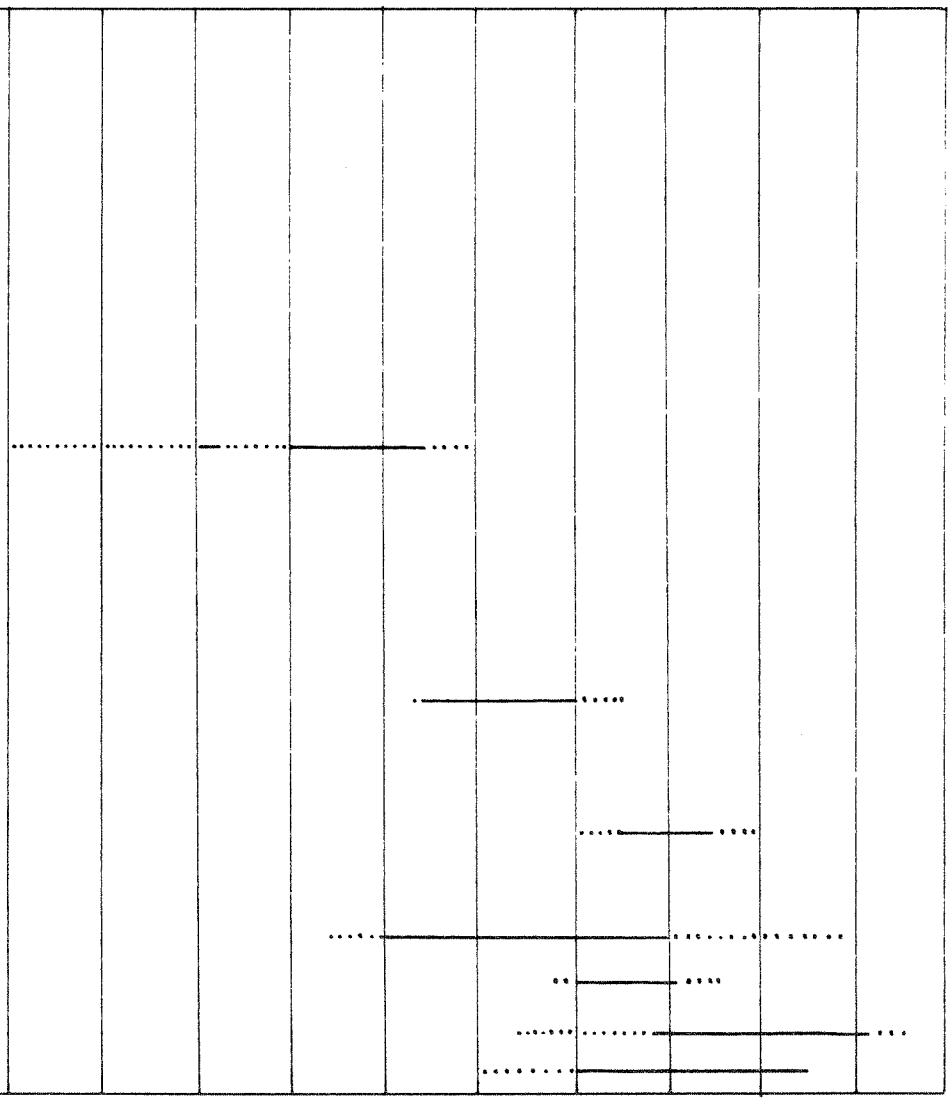
The migratory timing of chinook through the lower Fraser River is generally similar to that of sockeye, but precedes with various degrees of overlap the timing of pink, chum and coho, overlapping the least with chum salmon (Fig. 4). Comparison of the timing of the Fraser River chinook with other eastern Pacific rivers shows that the more southerly systems, particularly the Columbia and the Sacramento, have a similar range of dates of entry into the river, but that their chinook populations are more clumped during entry and have distinct, annually repeated peaks or "runs" (Mason 1965). The more northerly B.C. rivers, such as the Skeena and Taku, have a much more restricted range of entry dates and usually show only one "run" (Mason 1965). Larger rivers, such as the Columbia and Sacramento, generally show three "runs" (spring, summer and fall); smaller rivers may have only spring and fall runs. Typically, as in the Fraser River, the spring runs head for the upper tributaries, while the fall runs head for the lower tributaries closer to river mouth (Major et al. 1978).

Chinook spawning distribution, timing and behaviour

Chinook spawn throughout most of the Fraser River watershed with Rearguard Falls being a major barrier to these fish (Fig. 5). Spawning begins sporadically in early August, peaks in September and early October, and ends

Fig. 4. Estimated migration timing of most Fraser River chinook salmon stocks and other anadromous salmonids through the lower Fraser River fishery.

Chinook stocks	5-year mean escapement (1976 - 1980)
Early timing stocks	
Fraser River mainstem at Tete Jaune Cache	2,600
Tributaries above Prince George	6,400
Nechako River and tributaries	3,300
Chilko and Taseko Rivers	6,000
Other tribs. between Lillooet and Prince George	4,200
Lower Thompson River tributaries	800
Lower minor Fraser River tributaries	800
Total	24,100
Middle timing stocks	
All North Thompson River	5,300
All South Thompson River	14,200
Nicola River mainstem	3,300
Total	22,800
Late timing stocks	
Harrison River	14,500
Overall total	61,400
Sockeye	
Pink	
Chum	
Coho	



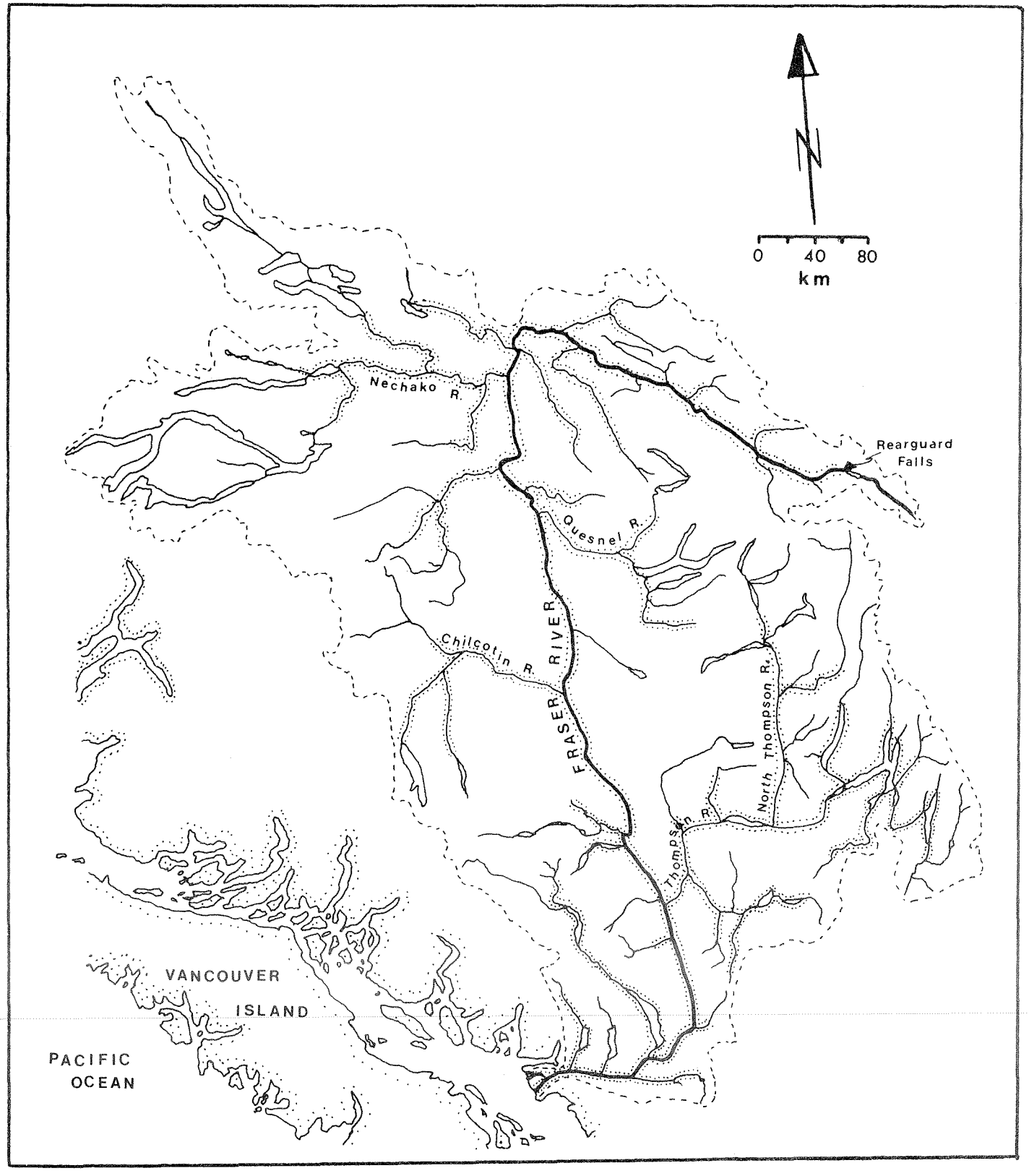


Fig. 5. Approximate extent of chinook salmon migration routes (dotted) in the Fraser River system.

by mid-November (DFO, unpublished data). The red chinook generally spawn until mid-October; the white (fall) Harrison River stocks generally spawn from mid-October to mid-November, peaking in early November.

Chinook utilize a wide variety of spawning habitats (Major et al. 1978). In general, an optimal chinook spawning area would be located in a relatively large, deep and fast flowing river containing coarse substrate. Redds are often located in a transition area between pools and riffles where maximum sub-gravel percolation occurs (Vronskiy 1972). Stream velocities may range from 0.3 m/sec to 1.5 m/sec (Major et al. 1978). Reported water depths at spawning sites range from 0.5 m to 4 m; gravel substrates range from fines (0.3 cm) to large cobbles (15 cm); and spawning temperatures range from 4°C to 18°C, with occasional reports above 20°C (Schmidt et al. 1979).

Redd construction is performed by the female facing upstream and dislodging gravel with her tail (Burner 1951). The female enlarges the redd in an upstream direction while releasing eggs. These are fertilized by the attending male and are covered by further upstream excavations (Burner 1951). Eggs are deposited to a depth of 5 cm to 50 cm (Schmidt et al. 1979).

Chinook age, weight and fecundity

Over 95% of both the red-and white-fleshed Fraser River chinook return to spawn in their third, fourth or fifth year with the four-year-olds being the dominant age class (>50% of total) during most years (Table 5, Append. 2). Two or three-year-old jacks (precocious males) are common in some Fraser River races, for example: the Harrison, Deadman and Shuswap Rivers; while six-year-old fish are negligible in number.

A general decline was observed recently in the size and age of chinook harvested commercially off the B.C. coast (Van Hyning 1973; Ricker 1980). The mean landed weight of the Fraser River red chinook has not changed appreciably since the 1950's, averaging 7-8 kg, but the harvested weight of white chinook declined from approximately 10 kg to the present 9 kg (Table 11). Also, the proportion of five-year-old Fraser River chinook (red and white) returning to spawn declined from around 20% to 10% since the 1950's (Table 5), but may have increased again in 1980 and 1981, as indicated by DFO test fishery data and preliminary spawning ground recovery data. A major cause for this decline may be the overharvesting of immature chinook by the sport and troll fishery. Ricker (1980) suggested that the practice of overharvesting younger fish leads to the selection of earlier maturing and smaller fish. The age data, however, are inconclusive due to changes in the scale reading methods in the past 20 years.

Fecundity of chinook females varies among the Fraser River tributaries and ranges from 3,000 eggs per female in the Deadman River, to 5,500 eggs in the Nechako River, to 6,500 eggs in the upper Fraser River (DFO, unpublished data). Rounsefell (1957) observed that chinook fecundity in the other North American rivers ranged from 2,600 to 8,400 eggs and was related to fish size. A maximum fecundity of 20,000 eggs was reported in the USSR for Kamchatka River chinook (Vronskiy 1972).

Table 5. Percent composition by age of red and white chinook captured in the Fraser River gillnet fishery, 1957-1978 (n gives sample size).[a]

Year	Age (years)[b] 2_1	3_1	3_2	4_1	4_2	5_1	5_2	6_2	n
Red chinook									
1957-1959	3	10	11	26	24	2	22	1	544
1964-1969	2	21	4	25	27	3	17	< 0.5	10,214
1975-1978	3	32	< 0.5	49	8	3	6	< 0.5	2,595
White chinook									
1957-1959	6	19	4	46	10	5	9	< 0.5	433
1964-1969	5	21	2	40	12	5	16	< 0.5	4,588
1975-1978	3	29	0	54	4	6	4	0	808

[a] Append. 2 lists data sources.

[b] Sub-index to age class refers to length of freshwater rearing phase,i.e. all sub-2 fish have entered the ocean in their second spring, after a full year of freshwater rearing.

COHO

Incubation

During incubation, coho eggs usually require approximately 400 to 500 degree-days (°C) before hatching, and a total of 700 to 800 degree-days (°C) before emergence (DFO, unpublished data). Depending on the timing of egg deposition, emergence of coho fry from gravel usually occurs from mid-March to late June (Godfrey 1965).

Dispersal and rearing of coho juveniles

Juvenile coho, like the "stream-type" chinook, typically rear in freshwater for a full year before migrating as smolts to the ocean (Gribranov 1948; Shapovalov and Taft 1954; Godfrey 1965). Northern systems, such as the Taku River, may have significant numbers of juveniles which spend a second year in freshwater and migrate to sea as two-year-olds (Meehan and Siniff 1962). This residualism was observed also in cold, unproductive streams of the Fraser River system, such as the Pitt River (Schubert, MS in prep'n) and the Coldwater River (Wightman, MS 1979).

A few coho fry may enter an estuary after only a limited freshwater residence, as was observed in the Fraser River where small numbers of fry-sized coho were beach seined in the North and South Arms in April, 1973 (Fisheries and Marine Service 1975). However, during the last 16 years of the spring operated juvenile monitoring program at Mission, few, if any, coho fry were captured there, suggesting negligible seaward migration at this stage (DFO, unpublished data).

Upon emergence from gravel, coho juveniles generally disperse downstream, and occasionally upstream (Stein et al. 1972), while a portion of the population may take up river residence in the vicinity of the spawning grounds. Chapman (1962) distinguished between two sub-populations of coho fry which he termed "nomads" and "residuals". The "residuals" are larger and more aggressive than "nomads", and probably take up-stream residence near the spawning grounds. The "nomads" disperse downstream, finding suitable rearing sites as they are encountered.

A general pattern of extended freshwater migration of rearing coho has become evident where many fry originating in the small tributaries migrate into the river mainstem for summer rearing, then as winter approaches, many of these migrate into the smaller side tributaries for overwintering. For example, Cederhold et al. (1981) tagged spring fry migrants in the Clearwater River in Washington, then recaptured tags in the autumn and the following spring in small side tributaries 50 km downstream. Similarly in the Chilliwack River (Fig. 1), coho juveniles tagged in the fall in Chilliwack Lake turned up the following spring some 40 km downstream in a small side tributary (Fedorenko and Cook 1982). Skeesick (1970) marked coho juveniles migrating upstream into a small Oregon tributary during fall. Subsequent spring trapping of downstream migrating smolts gave a mean overwintering survival of over 60% during a 10-year period. This indicates that the above dispersal behaviour of coho juveniles may be advantageous to the overall smolt survival, possibly because of better rearing areas encountered by such juveniles. Similar findings and interpretations were made for coho in Carnation Creek on Vancouver Island (Bustard and Narver 1975).

Competition between stream-rearing coho and rearing juveniles of chinook and steelhead trout is reduced by differences among species in emergence timing and/or rearing habitats. For example, coho adults generally spawn later than chinook, and coho fry emerge later from the gravel and are smaller, with a somewhat different habitat preference, compared to co-habiting chinook (Lister and Genoe 1970). Also, the observed upstream and downstream migration of coho juveniles into smaller tributaries (for example, Sixes River, Oregon) may serve to reduce the spatial competition with chinook (Stein et al. 1972). Interactions between coho and steelhead trout are reduced by differences in habitat preference. Fraser (MS 1968) showed in feeding behaviour studies that coho fry are more surface-oriented and utilize more diverse habitats compared to steelhed fry. Hartman (1965, 1968) observed that in the Alouette, Chilliwack and Salmon Rivers of the lower Fraser, rearing coho segregate during summer into a pool-type habitat, while steelhead juveniles seek out riffle areas; in winter, although both species reside in pools, they maintain a somewhat different distribution on the pool bottom.

Due to the extensive freshwater rearing phase of coho, their production appears to be directly related to the availability and quality of the stream rearing habitat (Chapman 1965; Fraser MS 1968; Burns 1971). Therefore, the production of coho smolts is probably directly related to the overall rearing area or length of stream. Other variables in the rearing stream which may affect smolt production include availability of nutrients such as phosphates and nitrates, composition of the stream habitat (pools, riffles and runs), and habitat complexity (pool depth, presence of stream bank cover and log jams, etc.). The present data are insufficient to include all the above variables into an overall model on carrying capacity of coho streams (Marshall and Britton MS 1980). However, assuming an adequate recruitment, the total coho smolt production in a given stream segment (and to a lesser extent, chinook freshwater smolt production) can be predicted if the measured area (or length) of that stream segment is known.

Coho smolt outmigration in the Fraser River and in other B.C. rivers generally occurs from mid-April to mid-June with a peak observed in mid-May (Foerster and Ricker 1953; Chapman 1962; Meehan and Siniff 1962; Lister and Walker 1966). Data from the Fraser River juvenile monitoring program at Mission, although incomplete, confirm the above timing (DFO, unpublished data).

Estuarine rearing of coho juveniles

The outmigrating coho smolts utilize the outer estuary in much the same way as do chinook smolts. However, this phase of coho life history is poorly documented. Sampling in the Fraser River during 1973 revealed a few coho fry and a considerable number of coho smolts (Fisheries and Marine Service 1975). In that study, some coho fry were observed in the North Arm from late April to mid-May, but were scarce in the South Arm and apparently absent from the Woodward Island - Deas Slough areas (Fig. 2). Coho smolts were found in all of the above sites from late April to mid-June. Purse seining and tow netting off the Roberts and Sturgeon Banks (Fig. 2) produced a considerable number of rearing coho smolts from mid-May to the end of August. Of the immature salmonids captured there, approximately 25% to 30% were coho, and the remainder mostly chinook (Fisheries and Marine Service 1975).

Ocean rearing of coho

After leaving freshwater, coho juveniles may show considerable variation in their subsequent seaward migratory patterns. Gribranov (1948) documented captures in estuaries of rearing coho that had left the river up to five or six months earlier. Since coho generally spend only some 18 months at sea, this may indicate a relatively brief ocean migration. However, coho in their first year of marine life have been also captured in the high seas, indicating that they can make extensive ocean migrations (Godfrey 1965). Similarly, tagged coho originating from Washington and Oregon streams, were recovered during their first summer of marine life off the southeastern coast of Alaska (Godfrey et al. 1975).

Among the Fraser River coho, some populations apparently rear in Georgia Strait or in Puget Sount ("inshore" coho), while others move off the west and northwest coasts of Vancouver Island and Washington ("ocean" coho) (Milne 1950). Argue et al. (1982) constructed a model of chinook and coho fisheries in Georgia Strait, and also divided the ocean rearing coho into "inshore" and "ocean" types relative to Vancouver Island. Evidence from the Fraser River adult tag recoveries indicates that the above rearing types are not stock specific, and a given Fraser River coho stock may be represented in both ocean rearing groups. This was found with Capilano River coho (Argue and Heizer 1974), Salmon River coho (Schubert 1982), and Chilliwack River coho stocks (Table 16). In addition, some coho appear to be "semi-resident" in Georgia Strait; they may rear there for several months, then leave for the open sea (DFO, unpublished data).

The extensive oceanic distribution of the Fraser River coho off the B.C. coast, around Vancouver Island, and south off the Oregon coast is documented by 1924 to 1971 recovery data of externally tagged coho in mixed-stock fisheries (Table 6). While the above data may reflect the stock composition at a given tagging site, it is impossible to estimate accurately stock composition due to inconsistencies among these studies regarding the effort expended on tagging and recovery. In general, of the coho recovered in the Fraser River, fewest came from fish tagged north of Vancouver Island and south of the Columbia River; moderate numbers were recovered from fish tagged off the west coast of Vancouver Island; and greatest numbers were recovered from fish tagged in Puget Sound and Georgia Strait (Table 6). The Fraser River coho recovered in Johnstone and Juan de Fuca Straits were probably mature coho returning from outside rearing areas.

Ocean-rearing coho increase in body length an average of 1.23 mm per day in their first summer, and 1.50 mm per day in their second and final summer (Godfrey et al. 1975). Rearing ocean temperatures range from 3°C to 16°C, with a preferred range of 8°C to 12°C (Godfrey et al. 1975). Ocean troll fishery data indicate that coho are usually captured in the upper 10 m zone (Godfrey 1965). Tag recovery data from the high seas indicate an ocean migration rate of 30 km per day for returning mature coho (Godfrey et al. 1975).

Coho adult migration timing

Over 150 tributaries of the Fraser River support coho stocks, among them chiefly the Thompson, Chilliwack, Harrison and Pitt Rivers, as well as miscellaneous small tributaries in the lower Fraser River. The identification of stocks as they pass through the Fraser River terminal fishery is as difficult for coho as it is for chinook and the available data are even more scarce. The best estimates of migration timing through the terminal fishery for the major Fraser River coho stocks are shown in Figure 6, and were

Table 6. Recoveries in the Fraser River of coho adults tagged with external tags in mixed-stock fisheries.[a]

Tagging location	Tagging years	References[b]	Total No. tagged	Total No. recovered	No. recovered in Fraser River
Southeast Alaska					
Inside waters	1924-'30.	A	2,737	464	0
Outside waters	1950.	A	848	76	0
North and Central B.C.					
Dixon Ent. and Dundas Isl.	1956-'58,'66-'68	A,B	4,232	864	1
Queen Charlottes	1929,'30,'51.	A	2,442	165	2
Browning End, Hecate St. Queen Charlotte Sd.	1929-'30,'66-'68.	A,B	3,457	468	1
Johnstone St. and Queen Charlotte Strait	1927,'28,'63, '65,'70,'71.	A,B,C	6,431	833	33(+1)[c]
Georgia Strait					
North of Parksville	1927,'28,'63-'66.	A,B	2,309	676	18(+3)[c]
South to Saanich (Canada)	1927,'28,'63-'69, '70-'71.	A,B,C	22,748	5,021	152(+16)[c]
Puget Sd. (US waters)	1964.	A	7,916	3,432	855
Victoria and Area 20					
Sooke Traps	1928,'29,'51.	A	307	65	9
St. of Juan de Fuca	1957,'58,'68-'69.	A,B	4,259	888	41(+2[c])
West Coast, Vancouver Isl.					
South (Area 21-23)	1925,'36,'49-'51, '69, '71.	A,D	2,359	398	11
North (Area 24-27)	1949-'51,'69.	A,D	1,397	143	8
Outside Waters					
Entrance, St. of Juan de Fuca	1957-'58.	A	4,120	805	41
Off Cape Flattery (Wash.)	1945.	A	659	144	16
Off Oregon Coast	1948-'49.	A	249	29	1
Off California Coast	1939-'49.	A	954	26	0

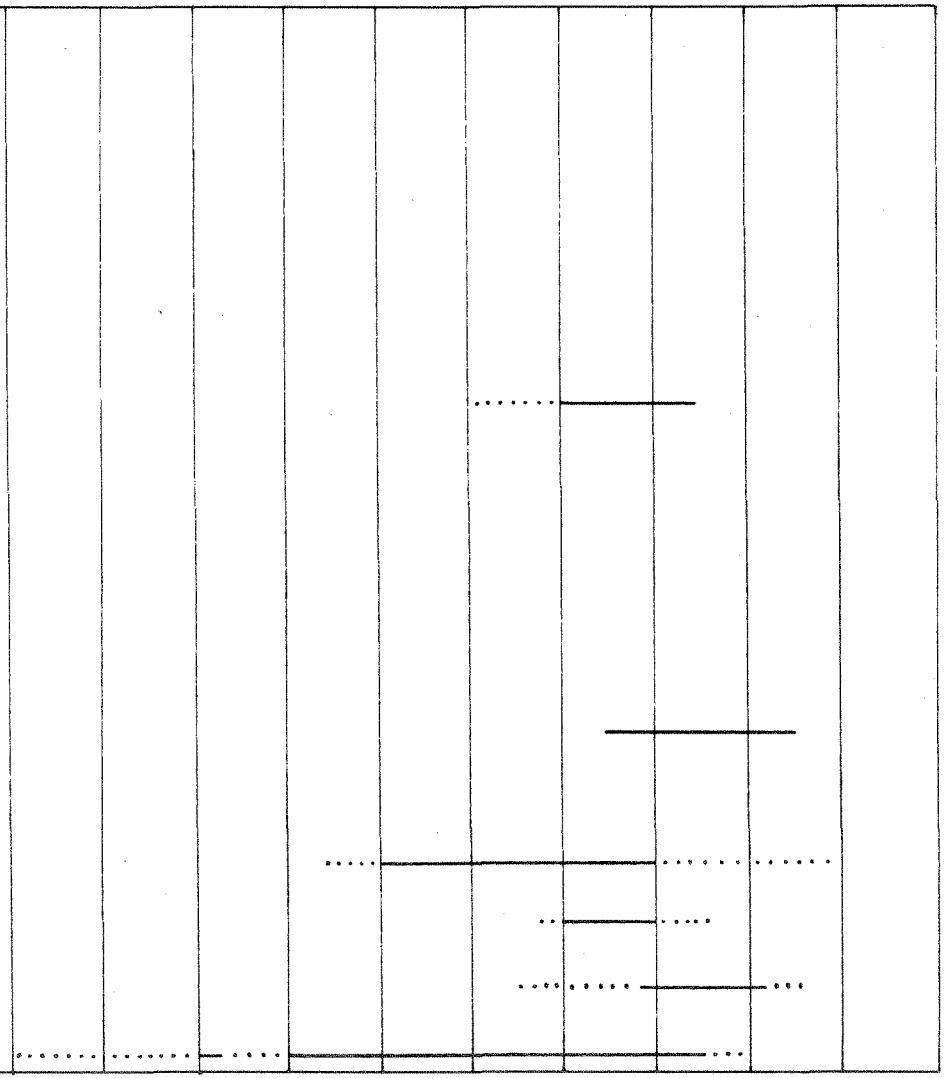
[a] B.C. data are complete to 1974, but U.S. data are only representative up to 1964 (Godfrey 1968a).

[b] See Table 4, footnote 'b'.

[c] Additional recoveries made just off the Fraser River estuary.

Fig. 6. Estimated migration timing of most Fraser River coho salmon stocks and other anadromous salmonids through the lower Fraser River fishery.

Coho stocks	5-year mean escapement (1976 - 1980)
Stocks above Hope	
N. Thompson River and tributaries	5,600
S. Thompson River and tributaries	5,500
Thompson River and tributaries	1,000
Miscellaneous other tributaries	2,400
Sub-total	14,500
Upper Lillooet River	7,000
Total	21,500
Stocks below Hope	
Harrison River and tributaries	6,100
Upper Pitt River	7,200
Vedder-Chilliwack River and tributaries	10,700
Miscellaneous other tributaries	11,800
Total	35,800
Overall total	57,300
Sockeye	
Pink	
Chum	
Chinook	



obtained generally by using chum test fishery data and by correlating the apparent abundance peaks in the terminal net fishery with the peaks on spawning grounds (see Fig. 24 and accompanying text for explanation). These migration estimates are subject to the same limitations as those previously discussed with regard to chinook.

The up-river coho stocks that spawn above Hope and especially the Thompson River stocks, as well as stocks from tributaries above Lillooet Lake (nearly 40% of the mean annual coho escapement to the Fraser River (1976 -1980 data, Append. 16a - e)), are believed to migrate through the Fraser River terminal fishery from August to October (Fig. 6). Most coho stocks bound for the lower Fraser River below Hope (over 60% of the mean annual coho escapement to the Fraser River (1976 - 1980 data, Append. 16f - j)) probably enter the mainstem somewhat later, from September to early November, depending on specific stock. This is supported by chum test fishery data where relatively few coho were observed after mid-November. Lower river coho stocks may hold in the river a considerable time after initial entry, then spawn in December and January, as observed for coho in the Vedder-Chilliwack River system.

The migratory timing of coho through the lower Fraser River is generally later than that of the majority of sockeye and chinook, but overlaps strongly with the timing of pink and chum (Fig. 6). The above observations on the time of entry by coho into the Fraser River (and preferred spawning dates - see below) are consistent with observations for other eastern Pacific Rivers (Neave 1949; Sumner 1953; Shapovalov and Taft 1954; Godfrey 1965; Lister and Walker 1966).

Coho spawning distribution, timing and behaviour

Most Fraser River coho spawn in tributaries mainly below and including the Thompson River system (Fig. 7). Recently, isolated reports of coho sightings were made in the Quesnel River (Whelen et al. MS 1981) and the Chilcotin River (J. Leggett, Fish and Wildlife Br., pers. comm.) systems. Fraser River coho begin to spawn more than two months later than chinook. The up-rover coho start spawning in mid-October, peaking probably in November (DFO, unpublished data). The North Thompson River stocks have been observed spawning under ice floes and amidst anchor ice (L. Kahl, DFO, pers. comm.). The lower Fraser River coho spawn mainly in December, although spawning in November, January and February is also common (Schubert 1982). Even late March spawning was observed in the small tributaries of the Chilliwack River system (B. Mitchell, DFO, pers. comm.).

Compared to chinook, coho spawn usually in smaller tributaries with lower velocities, shallower depths, and smaller substrate gravel. However, due to a considerable overlap in the spawning site preference of coho and chinook, it is not uncommon to find redds of both species side by side; Burner (1951) makes no distinction in his descriptions of the typical spawning sites of coho and fall chinook. Some of the observed coho spawning parameters include: water velocity (0.08 - 0.7 m/sec); stream depth (0.05 m - 0.66 m); diameter of gravel substrate (2 cm - 15 cm); and water temperature (4°C - 14°C) (Schmidt et al. 1979). The behaviour of coho during redd excavation and spawning is similar to that described above for chinook.

Coho age, weight and fecundity

The age composition of returning coho, as indicated by samples from the

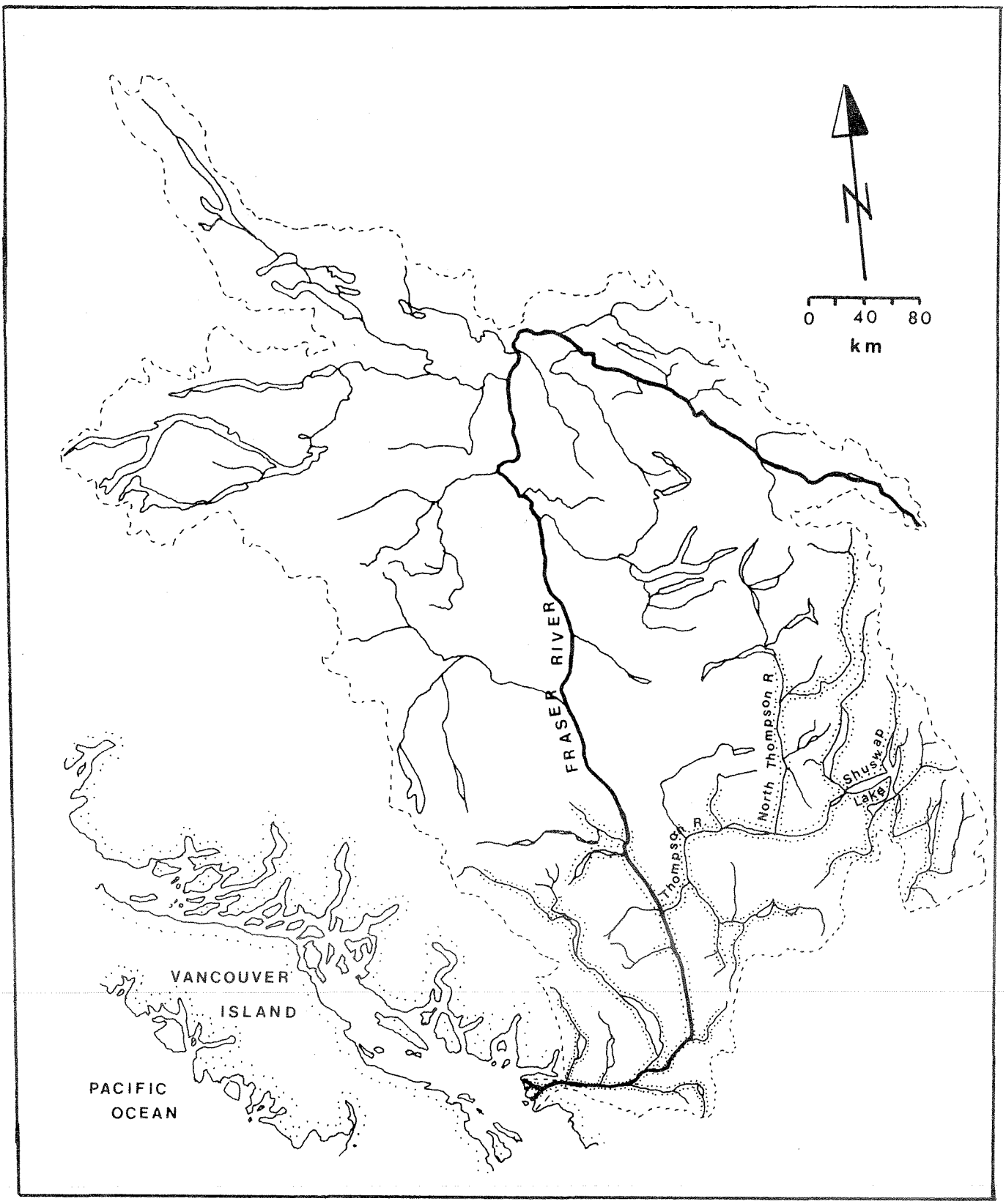


Fig. 7. Approximate extent of coho salmon migration routes (dotted) in the Fraser River system.

Fraser River gillnet fishery, is dominated by three-year-olds (92% of total sample) (Table 7). Approximately 4% of the returning coho are four-year-olds, having reared an extra year in fresh water, and another 4% are jacks, precociously mature males returning to spawn at age two.

The mean landed weight of coho in the terminal net fishery appears to have declined since the 1950's from about 3.5 kg to 2.8 kg (Table 15). Fecundity of the lower Fraser River coho is estimated at 2,500 to 2,700 eggs per female (Inch's Creek and Chilliwack River hatchery data, C. McKinnon, DFO, pers. comm.). This is similar to the fecundity of the coastal B.C. coho in general (2,100 to 2,800 eggs per female (Godfrey 1975)), and to the overall mean fecundity of the eastern Pacific coho (approximately 2,600 eggs per female (Rounsefell 1957)).

FISHERIES

COMMERCIAL FISHERY

Development and management

Early history of fishery: The first cannery on the Fraser River was built in 1866 (Rounsefell and Kelez 1938). Sockeye rapidly became the most important canned species because of their great abundance, as well as high oil content and deep red flesh colour that enhanced the product value. Any chinook caught incidentally to sockeye at this time were generally thrown overboard (Lyons 1969). Coho, also of lower value, were usually disposed of in the same manner, but some were processed by one cannery in 1887 (Fig. 8) when an "off" year for sockeye occurred (Reid 1973). In addition to fresh market sales, early chinook catches and a portion of the coho catch were also "mild-cured", whereby fish were salted lightly, then immersed in brine and "cold"-smoked (Lyons 1969).

Probably the greatest stimulant to the chinook and coho fishery was the construction of freezer storage on the Fraser River in 1886 (Rounsefell and Kelez 1938). The demand for chinook and coho has since increased tremendously, and the two species are now highly valued as both fresh and frozen products.

The catch data in this report are summarized for the period 1951 to 1980. Prior to 1951, comprehensive catch statistics were not maintained by the Department of Fisheries and Oceans. Instead, catch was reported as total pack of canned salmon by species and by cannery. This method lacked much biological information and the data are difficult to compare with modern catch statistics. In addition, sales of salmon preserved by methods other than canning were ignored, adding considerable bias to chinook and coho catch records as other commercial outlets predominated over the canned pack.

Statistical Areas: Since 1951, the coast of British Columbia has been divided by the Department of Fisheries and Oceans into 31 Statistical Areas (Fig. 9) for the purpose of tabulating catch data. The Fraser River and waters adjacent to its mouth are designated Area 29. This area is further subdivided into Area 29A (most of Georgia Strait lying between Gabriola Island, Howe Sound, the Steveston jetty and the International Border), Area 29B (the Main Arm of the Fraser from Steveston jetty to Patullo Bridge), Area 29C (the North and Middle Arms of the Fraser), and Area 29D (the Fraser River

Table 7. Percent composition by age of coho captured in the Fraser River gillnet fishery, 1961, 1962, 1964 and 1975 (n gives sample size).[a]

Year	Age (years)[b] 2_1[c]	2_2	3_1	3_2	4_2	4_3	n
1961	1.8	0	0	95.4	0	2.8	109
1962	0.3	0	1.9	95.9	0.3	1.6	315
1964	6.4	0.1	0.1	87.3	0.3	5.8	770
1975	0	0	0	100.0	0	0	116
Mean	4.0	0.1	0.5	91.1	0.2	4.0	1,310

[a] Data compiled from unpublished sources at Pacific Biological Station: 1961-1964 data by Ball and Godfrey; 1975 data from Mark Recovery Programmes (R. Forbes, pers. comm.). All samples were collected from the commercial Fraser River gillnet fisheries during August to October, and are subject to bias due to restricted net sizes used and limited fishing periods.

[b] See Table 5, footnote "b".

[c] Length of freshwater stage is questionable due to suspected scale reading methods.

Fig. 8. Ewen's fish cannery on the Fraser River, 1887 (Vancouver Public Library, Negative No. 1788).

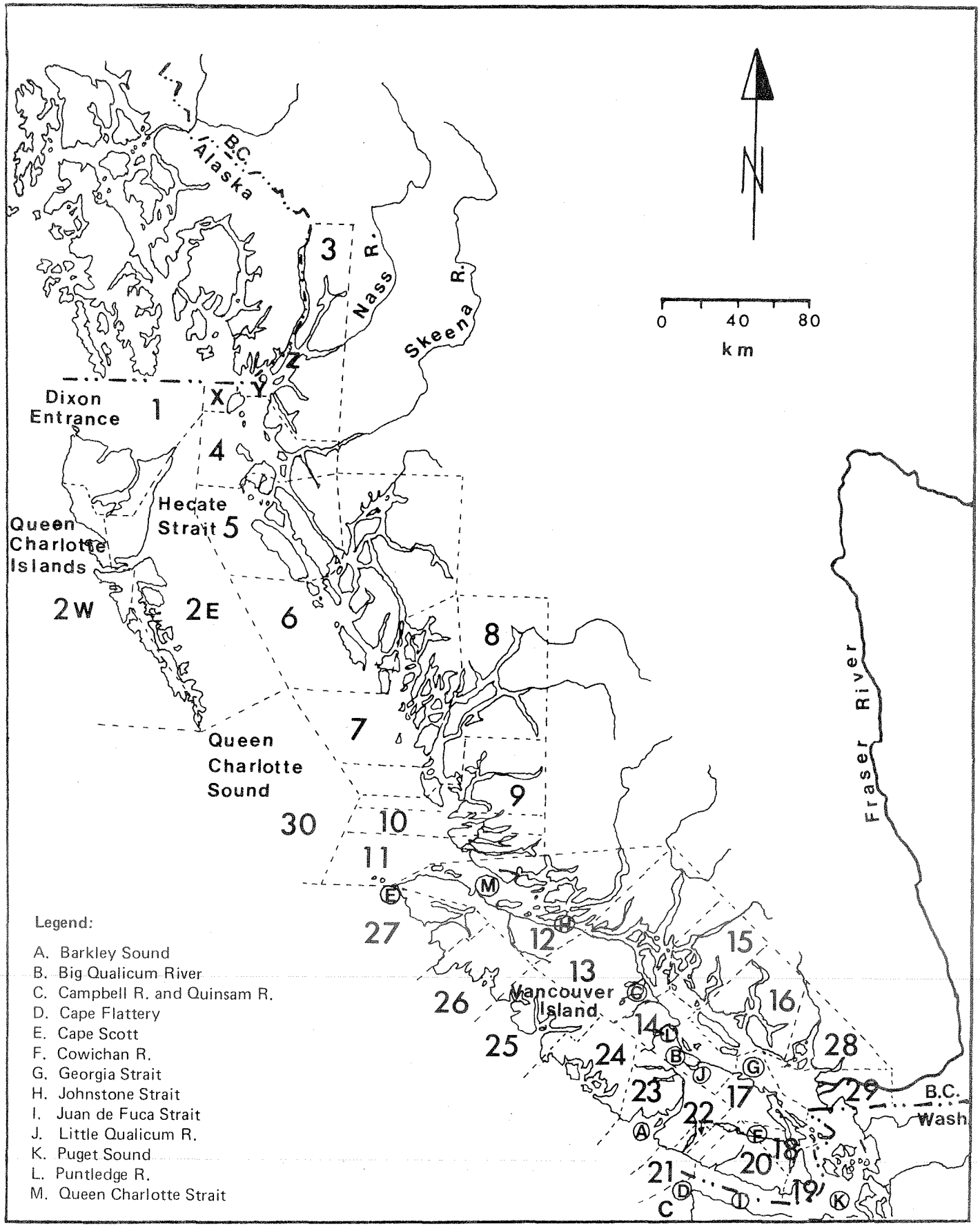


Fig. 9. Coast of British Columbia showing Statistical fishing Areas (1 - 30 and C) and major geographical features.

from Patullo Bridge to Mission Bridge) (Fig. 10). The Fraser River is also divided into two administrative districts and 12 sub-districts (Append. 14) for the purpose of enforcement, habitat protection and escapement estimation.

Most of the catches reported in the various B.C. Statistical Areas are from mixed stocks, often including Fraser River chinook and coho in unknown proportions. Exceptions are the gillnet catch in Areas 29 and catches from several terminal net fisheries where known stocks are harvested.

The International Pacific Salmon Fisheries Commission (IPSFC): The IPSFC, a joint regulatory body, set up in 1937 by the United States and Canada, is responsible for managing Fraser River sockeye and pink salmon (the latter species added in 1957) and for dividing the total pink and sockeye catch from the Convention Area (includes Areas 29A-D) evenly between the fishermen of both countries (IPSFC Annual Report 1979). Within the Fraser River area, the IPSFC regulates the late June to early October fishing period (Append. 3) which accounts for about 90% of the total commercial catch of all salmon species in some years. The fishing season prior to and after the IPSFC control is managed by the Department of Fisheries and Oceans.

Trap fishery: In the early years of the salmon fishing industry, fish traps, although never used in the Fraser River, were of considerable importance in both the Puget Sound and the Sooke fisheries (Fig. 10), two areas where traps were likely to catch migrating Fraser River chinook and coho.

The first trap was built in 1880 (Rounsefell and Kelez 1938) at Point Roberts (Fig. 10) and subsequent traps followed its basic design: a barrier or "lead" net hung from a row of pilings, diverting passing fish into a rectangular "crib" similarly constructed (Fig. 11). An improved arrangement of additional nets and wire mesh was developed by the 1890's which minimized the chance of fish excaping. It was several years before fishermen discovered the best locations for successful interception of runs and eventually became so skillful at placing traps that in 1897, the Washington State Fisheries Department introduced trapping restrictions on the depth of water fished and length of lead placed, as well as a provision for a 730 m corridor between traps and a minimum corridor of 180 m around trap ends (Rounsefell and Kelez 1938).

The fish trapping season originally lasted in most areas only from July to August when the sockeye run was intercepted. This was gradually extended to a period from early May to late October in order to permit the capture of spring and fall chinook and of coho runs. Beginning in 1921, fall closures were imposed in a number of areas in order to protect sockeye runs, but since only a few weeks in late August and early September were closed to fishing, there was little effect on chinook and coho escapements (Rounsefell and Kelez 1938).

Traps were abolished in 1934 in the State of Washington (Rounsefell and Kelez 1938) and were voluntarily discontinued in 1958 at Sooke since they could not exist profitably, fishing only during commercial net openings (Argue 1970).

Gillnet fishery: Gillnets are the most important gear type used in the Fraser River commercial fishery. They were introduced with the advent of canneries (about 1866) and their use on the river increased with expanding

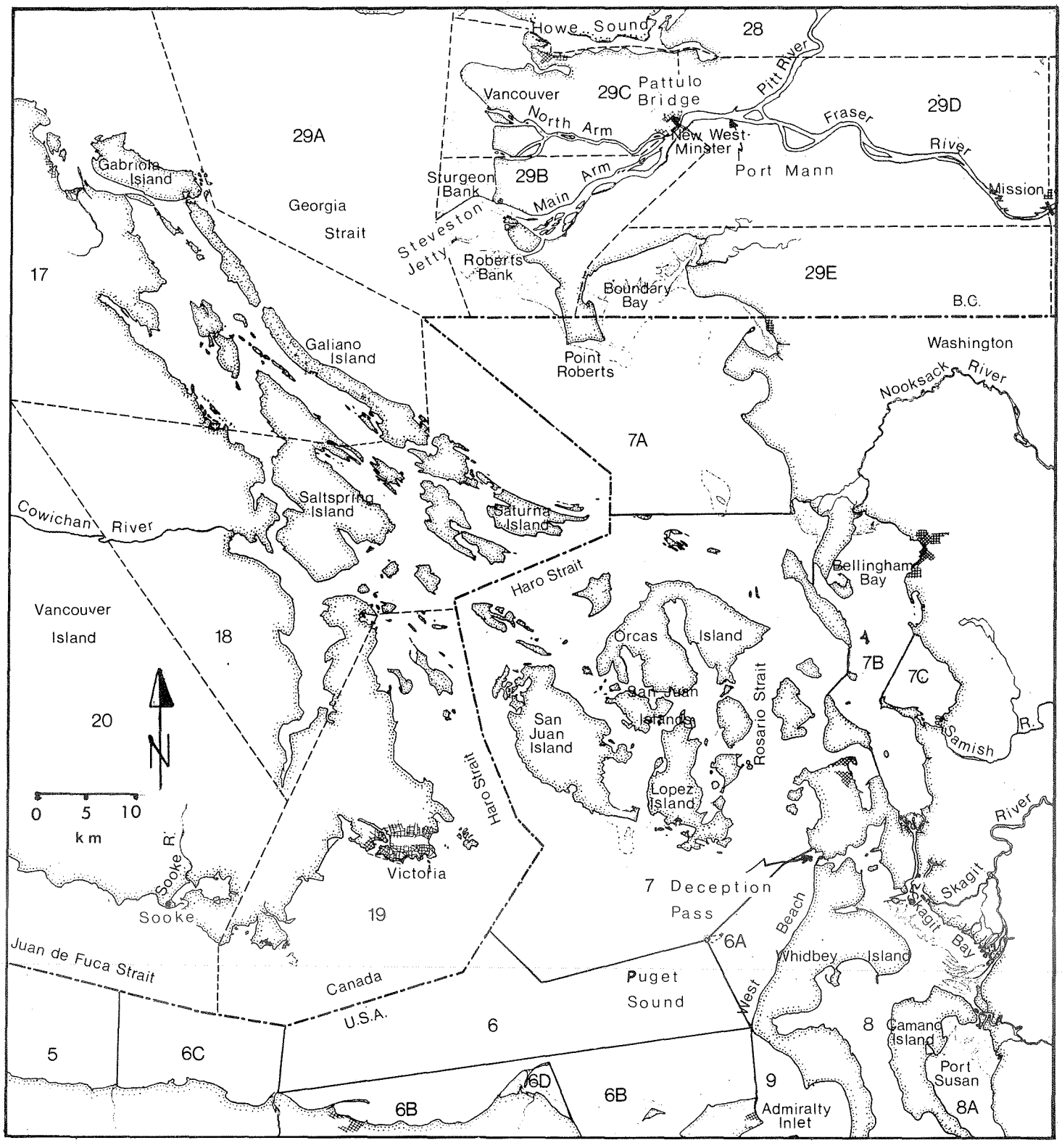


Fig. 10. Southern Georgia Strait and northern Puget Sound showing the southern approaches to the Fraser River and the Canadian and American Statistical fishing Areas.

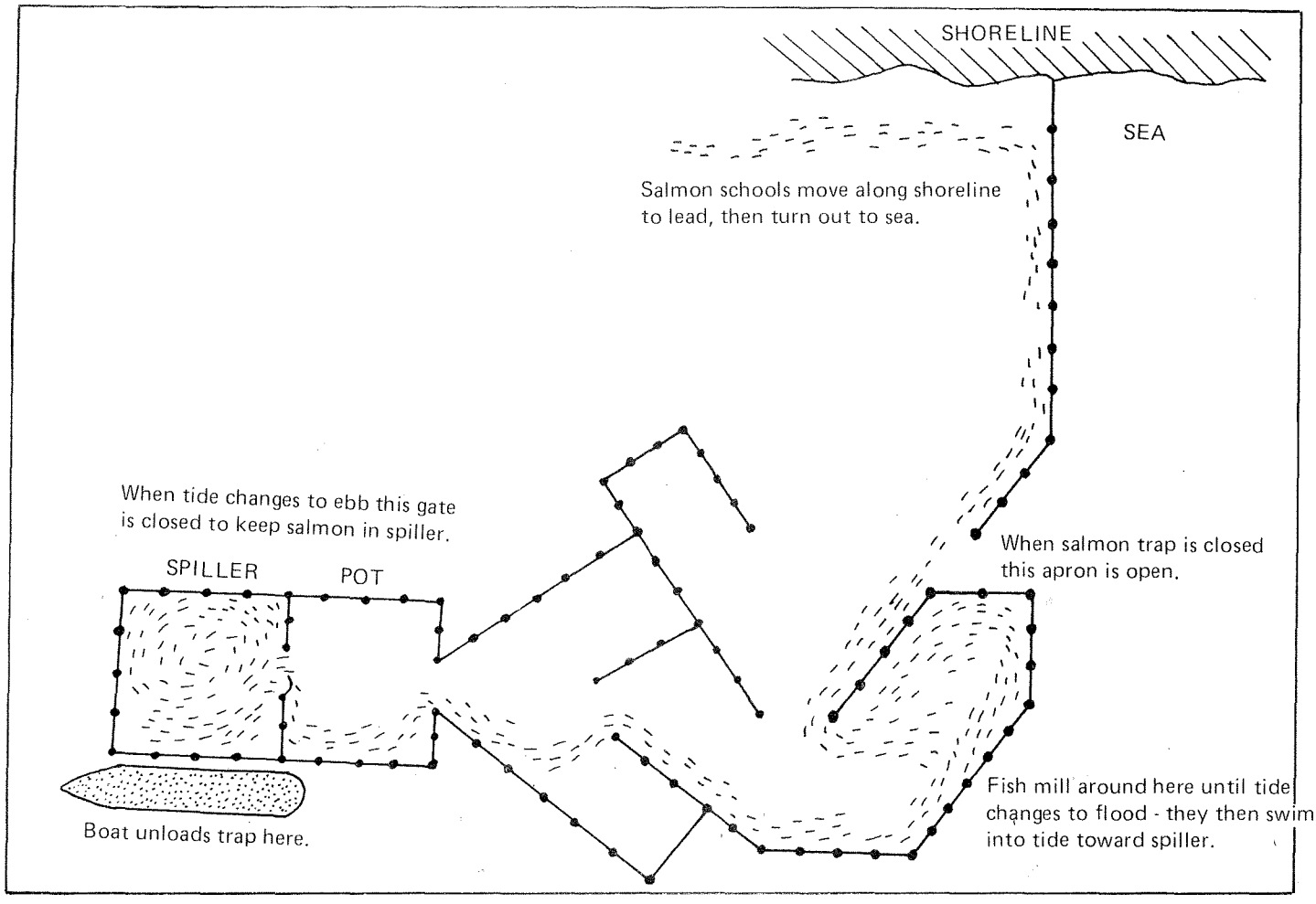


Fig. 11. Diamond salmon trap in operation (from: "Pot and Spiller", Sooke Region Historical Society publication, July 1977).

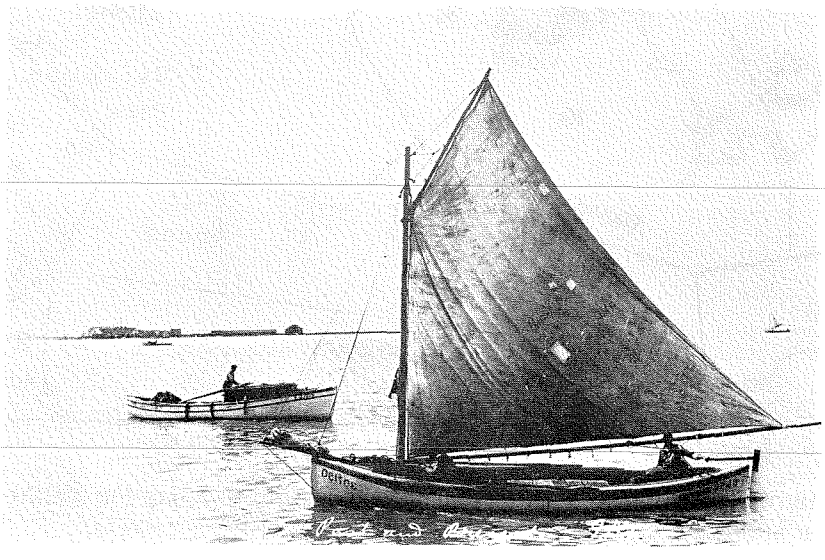


Fig. 12. An early fishing boat under sail, with Steveston cannery in the background (Vancouver Public Library, Negative No. 2041).

salmon catches in the late 19th century (Rounsefell and Kelez 1938). The standard gillnet, operated in the early days of the Fraser River fishery, was approximately 275 m (150 fathoms) long, with a mesh size (stretched) of 14.9 cm (5-7/8"). The net depth varied somewhat, but rarely exceeded 50 meshes (Rounsefell and Kelez 1938). The original nets were made of linen, but were changed to nylon in the early 1950's (Lyons 1969). Modern nets are set by regulation to a maximum length of 366 m (200 fathoms) and a depth of 60 meshes. Prior to recent conservation measures, a 15 cm (6") or smaller stretch mesh size was used typically for sockeye, pink, and coho salmon, while a 16.5 cm (6½") to 21 cm (8½") stretch mesh size was used primarily for chum and chinook respectively (D. Aurel, DFO, pers. comm.).

In the early years, the nets were set from 6 m two-oared skiffs, usually manned by two men. In the 1890's these skiffs were gradually replaced by 9 m round-bottomed sailboats which were more stable and safer in open water (Fig. 12). Gasoline engines were introduced in 1902 and became a common feature by 1914 (Rounsefell and Kelez 1938). The refinement of fishing techniques and major advances in boat and net gear technology have continued over the years, resulting in increased efficiency of the fleet. Management regulations in the Fraser River have also gradually changed to reduce the impact of this higher fishing efficiency in order to ensure adequate spawning escapements.

The gillnet fishing season in the Fraser River can be divided into three regulatory periods: 1) the early season, prior to the IPSFC control (from opening day to approximately the end of June) when chinook is the only species exploited; 2) the middle season, during the IPSFC control (from end of June to early October) when sockeye, pink, chinook and some coho are the major species exploited; and 3) the late season after the IPSFC control (from early October to late November) when chum is the major species exploited.

Changes in management regulations in the Area 29 gillnet fishery to conserve the declining chinook stocks have been imposed largely during those periods not under the control of the IPSFC. Major regulations introduced since 1951 include: a later opening date for net fishing (changed from February 1 to mid-April and, starting in 1981, complete elimination of the early chinook fishery); a reduction in the number of days per year allowed for fishing (from 189 days in 1952 to 15 days in 1981); and the imposition since 1974 of maximum net size regulations (generally 14.9 cm (5-7/8") but 14.0 cm (5½") in 1981) during July to September in order to harvest selectively sockeye instead of chinook (Append. 3). The above measures have been relatively successful in reducing the net catches of chinook in Area 29 where most chinook landings are incidental to target fisheries on sockeye, pink and chum salmon.

Troll fishery: Fishing by hook and line for chinook and coho had been practiced by native Indians before the advent of white man on the Pacific coast, but the commercial troll fishery was not developed until the introduction of motorized vessels in the early 20th century (Rounsefell and Kelez 1938). In the late 1960's and during the 1970's, the troll vessels evolved from ice-carrying day boats to much larger freezer boats and day boats, capable of fishing larger areas for longer periods of time. This resulted in increased catches and in catch statistics that are difficult to interpret regarding correct timing and location of catch. In recent years, sockeye and pink joined chinook and coho as important troll-caught species.

Modern trollers often venture over 150 km from the coast and are equipped

with a variety of electronic devices. Trollers generally fish four to 12 trolling lines with from two to 12 lures per line (in 1981 trollers were restricted to a maximum of six lines). Trolling lures are fished from the surface down to 60 fathoms (110 m), depending on the species caught, the time of year and the fishing location.

Most of the Fraser River commercial troll fishing occurs in Area 29A, with limited trolling also occurring just off the mouth of Fraser River (Areas 29B and C) (Fig. 10). Consequently, the troll catch of chinook and coho in Area 29 includes fish destined for non-Fraser streams as well as fish destined for the Fraser River (Argue et al. 1982).

The British Columbia troll fishery has, until recently, been subject to realtively few regulations by the Department of Fisheries and Oceans. The major regulations have concerned season length and fish size. Inside Georgia Strait, the size of troll-caught chinook or coho is restricted to 1.4 kg (3 lb.) round or 1.1 kg (2.5 lb.) dressed weight. Outside of Georgia Strait, the size of captured chinook is restricted to a minimum of 66 cm (26") total length (tip of nose to tip of tail), while the coho size limit remains as for inside of Georgia Strait. Season length inside the Georgia Strait, effective since 1965, has been April 15 to September 30 for chinook and July 1 to September 30 for coho. Outside of Georgia Strait, season length, effective since 1958, has been April 15 to October 31 for chinook and June 15 to October 31 for coho (DFO, unpublished data). In 1981, the outside troll fishery was restricted from April 15 to September 30 for chinook and July 1 to September 30 for coho.

Troll fishing in Area 29 is open only when gillnet fishing takes place. This is in contrast with the rest of Georgia Strait where trolling is allowed seven days a week during the open season. The target species in the Area 29 troll fishery in the early part of the season is chinook, followed by sockeye, pink and coho as they become available. In 1981, the early season gillnet and troll fisheries for chinook in Area 29 were closed. The later troll fishery in Area 29, targeting on sockeye and pink, was allowed to continue, provided all captured chinook were released.

Commercial fisheries on Fraser River chinook and coho stocks outside Area 29: Fraser River chinook, and to a lesser extent coho, migrate extensively along the B.C. and Alaskan coasts (Tables 4 and 6). Depending on where they feed, these salmon are vulnerable for much of their marine life to troll gear, and to both troll and net gear along their migratory routes. In particular, fishing boats in the narrow Johnstone and Juan de Fuca Straits leading to the inside waters of Vancouver Island (Fig. 9), form a formidable gauntlet of nets which must be passed by all migrating Fraser River salmon (Argue 1970). Finally, a significant proportion of the catch of Fraser River chinook and coho stocks is made in the waters inside (east) of Vancouver Island. These possibly resident (partially or totally) fish, together with the less vulnerable returning migrants (Argue 1970), are subjected in Georgia Strait to an intense and efficient troll fishery, and to an even more effective sport fishery (Argue et al. 1982).

The above exploitation, which occurs prior to the terminal net fishery in Area 29, is very difficult to quantify at present because the stock composition in each fishery is unknown, and the available tagging data are difficult to interpret (see section on "Ocean rearing of chinook"). Tagging of salmon with internal coded wire tags holds much promise to solve this

problem. Coded wire tagging of wild chinook and coho stocks and of hatchery populations is currently underway in the Fraser River watershed.

CHINOOK

Chinook trap fishery

During 1927 to 1934, Puget Sound traps accounted for 39% of the overall mean annual catch of chinook in the Puget Sound area (Fig. 10), and nearly equaled the total chinook troll catch made during that time in the rich feeding grounds off the southern Vancouver Island (Table 8). Trap captures north of Deception Pass (Fig. 10) accounted for 54% of the total Puget Sound trap catches of chinook (1915 - 1934 data; Rounsefell and Kelez (1938)). The Fraser River, by far the largest producer of chinook in this area, may have accounted for a large proportion of the total catch north of Deception Pass (Milne 1964a). Chinook trap catches in the Puget Sound declined only slightly during 1915 to 1934 (Fig. 13); trap catches at Sooke during 1922 to 1958, show a more obvious decline with time (Fig. 14).

Chinook gillnet fishery, Area 29

The annual (five-year mean) gillnet catch of chinook in Area 29 averaged 112,000 pieces in the last 30 years and declined by about 60% since the early 1950's (from approximately 155,000 fish to 63,000 fish by the late 1970's) (Fig. 15, Table 9). This decline was particularly sharp in the last decade (the 1981 gillnet catch dropped to only 22,000 chinook (DFO, preliminary data) due to low fish abundance and strict regulations designed to reduce incidental catches of chinook). A small part of the catch made in Area 29A (probably less than 2% of the total Area 29 catch) is of "non-Fraser River" origin since other stocks also frequent there, as indicated by tag recovery data (DFO, unpublished data).

Landings declined by 75% during the last 30 years, and the annual (five-year mean) total landed weight dropped by 61% since the early 1950's (from 1,199,000 kg to 472,000 kg by the late 1970's) (Append. 4). Since this drop is proportionate to the catch decline, little overall change occurred since the 1950's in the mean landed weight per fish (7 kg - 8 kg) (Table 9). However, there is some suggestion that the mean weight of fish declined in the late 1950's and early 1960's, only to recover to the former levels by the 1970's.

The highest monthly contributions to the mean annual (1951 - 1980) chinook gillnet catch were generally made by the landings in July, August and September (22%, 23%, and 25% respectively), while the June catch contributed 14%, and the remaining months some 4% to 7% each (Fig. 16, Append. 5). The above seasonal trend is detailed in the weekly (1969 - 1978) catch data where landings were lowest in April (≤500 fish per week); increased slowly from May to July; peaked to over 6,000 fish per week in late August, first half of September and beginning of October; then declined abruptly towards the end of October (Fig. 17).

The seasonal contributions to the annual catch changed during the period of record. Early season catches (start to June 30) which generally contributed 15% to 31% to the annual catch (five-year means), declined the most since the 1950's (by 70%; from 39,000 fish to 12,000 fish by the late

Table 8. Summary of early chinook fishery catch data for areas in and around Puget Sound (1927-1934 mean data).[a]

Type of fishery	Mean annual catch	% of Total
Traps		
Puget Sound	188,000	39%
Purse seine		
Puget Sound	18,000	4%
Juan de Fuca St.	9,000	2%
Troll		
Puget Sound	2,000	< 0.5%
Swiftsure Bank	193,000	40%
Gillnet		
Puget Sound Rivers	32,000	7%
Fraser River[b]	40,000	8%
Minor gear		
Puget Sound	1,000	< 0.5%
Annual total	483,000	100%

[a] From: Rounsefell and Kelez (1938).

[b] Fraser River catch converted from cases of canned fish; fish caught for purposes other than canning not included.

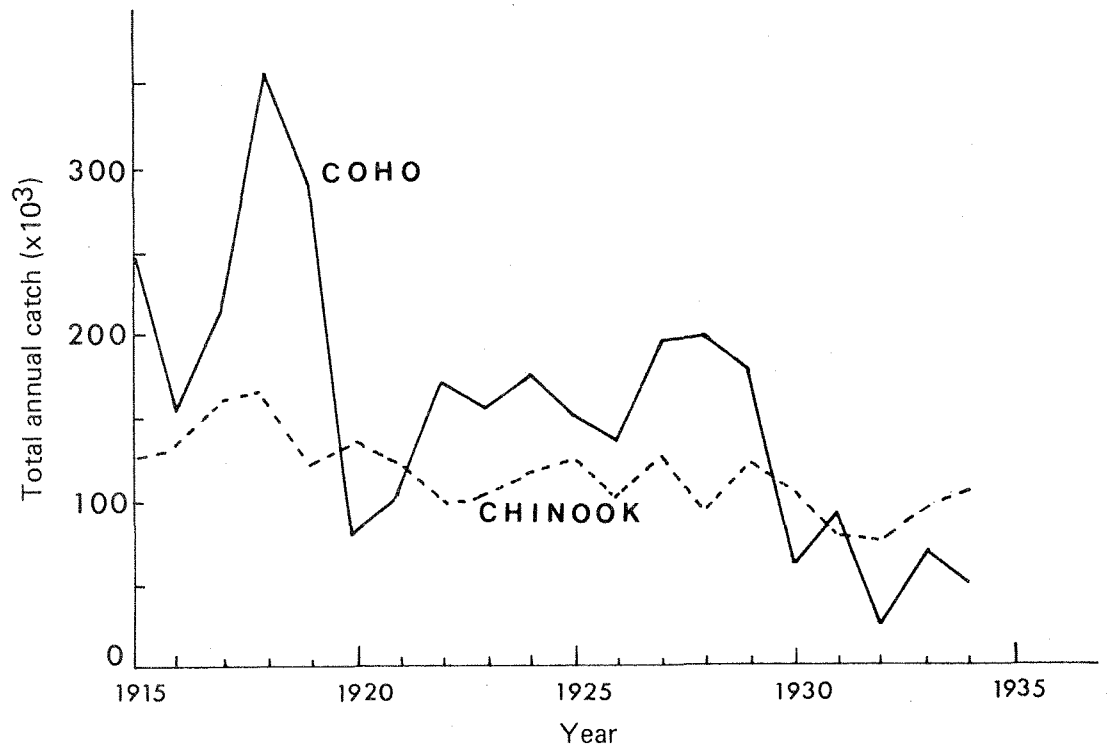


Fig. 13. Total annual trap catches of chinook and coho in Puget Sound, north of Deception Pass (north end of Widbey Island), 1915-1934 (from: Rounsefell and Kelez, 1938).

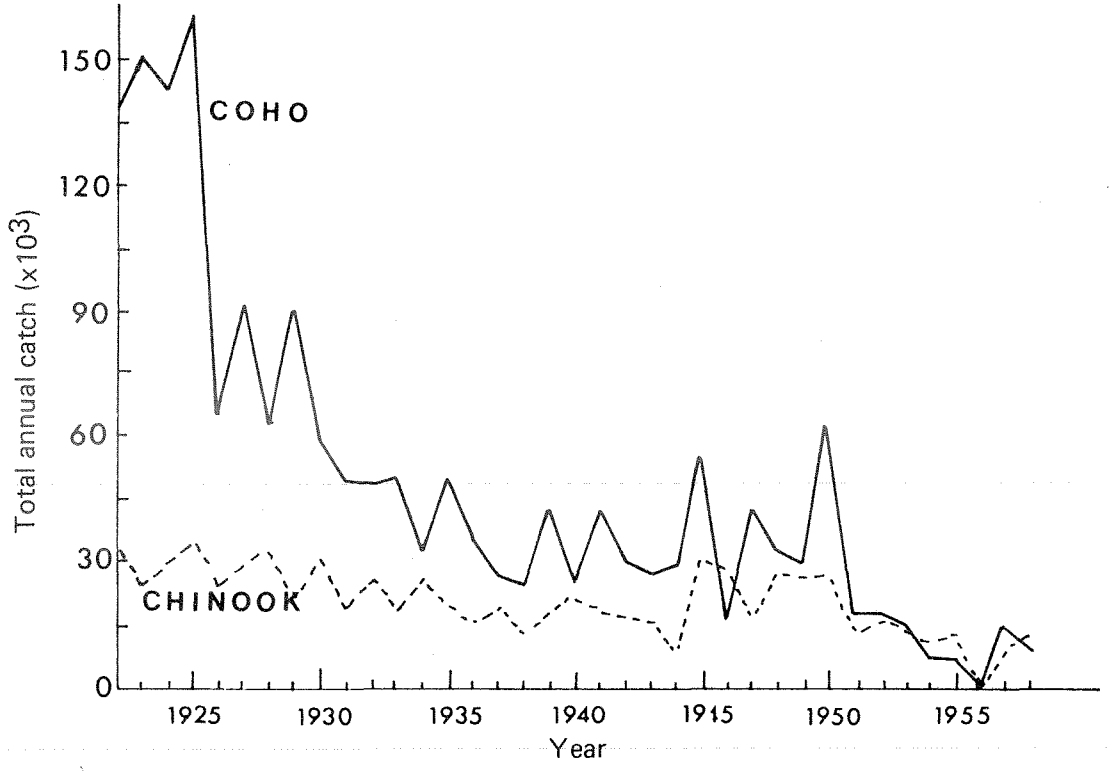


Fig. 14. Total annual trap catches of chinook and coho at Sooke (southern end of Vancouver Island), 1922-1958 (from: Argue 1970).

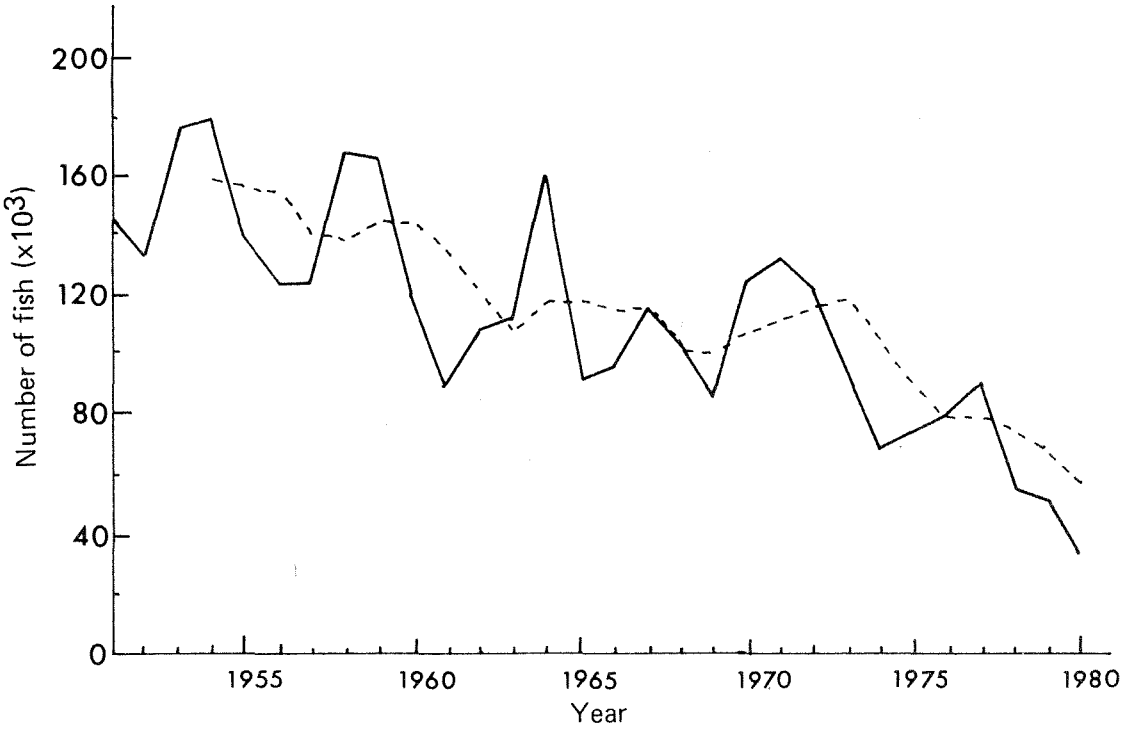


Fig. 15. Annual commercial gillnet catch of chinook and four-year sliding average (dotted line), Area 29, 1951-1980.

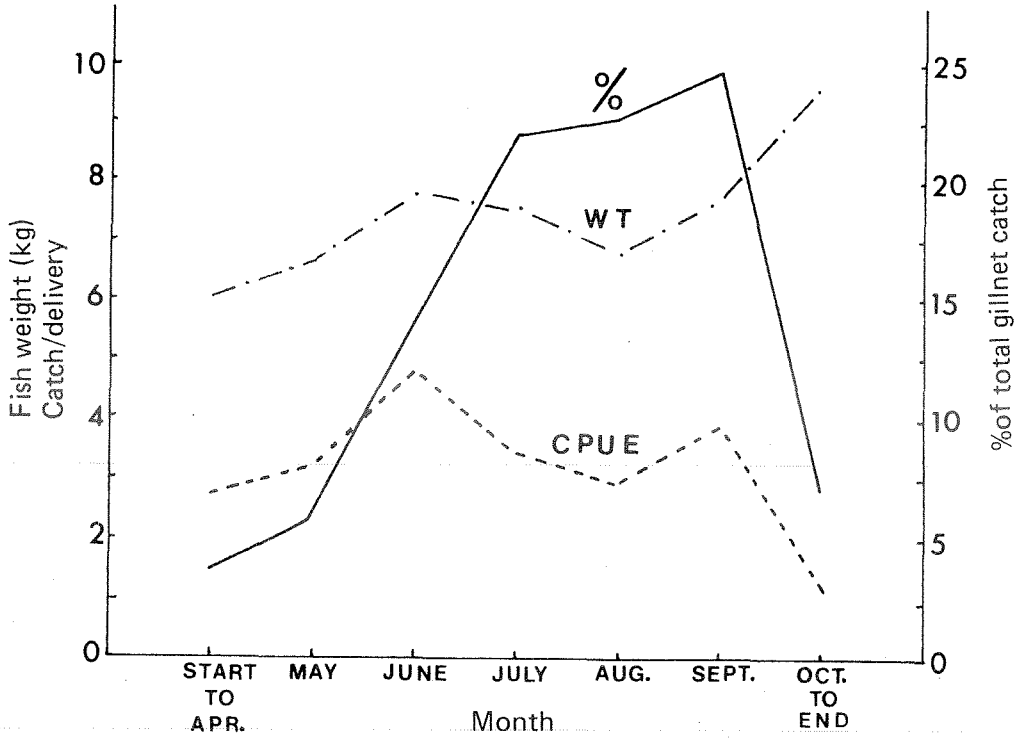


Fig. 16. Mean monthly landed (round) weight per fish, catch per delivery (CPUE) and percent contribution per month of gillnet-caught chinook, Area 29, 1951-1980.

Table 9. Annual chinook gillnet and troll catches, percent of total catch by gear type, catch per unit effort, and mean weight per fish, Area 29, 1951-1980.

	GILLNET				TROLL				
YEAR	CATCH	% OF TOTAL CATCH	CATCH PER DELIVERY	MEAN WEIGHT PER FISH (KG)[a]	CATCH	% OF TOTAL CATCH	CATCH PER BOAT-DAY	MEAN WEIGHT PER FISH (KG)[b]	TOTAL COMMERCIAL CATCH[c]
1951	147197	99.99	1.78	7.83	20	0.01	2.00	9.07	147217
1952	131800	99.97	2.14	7.19	37	0.03	12.33	4.90	131837
1953	176142	99.91	2.67	7.87	165	0.09	20.63	4.12	176307
1954	179082	99.99	2.55	8.24	11	0.01	1.22	N/A	179105
1955	139087	98.87	2.98	7.42	1586	1.13	8.91	3.20	140673
1956	123137	99.02	3.10	7.88	1224	0.98	6.65	3.34	124361
1957	123633	96.80	3.21	5.68	4088	3.20	18.41	2.37	127721
1958	167288	99.06	2.83	6.94	1590	0.94	11.12	3.11	168878
1959	165736	98.67	3.56	7.61	2241	1.33	7.35	2.83	167977
1960	119510	95.84	3.05	7.61	5184	4.16	13.86	2.05	124694
1961	89042	96.07	2.17	7.77	3638	3.93	8.89	2.46	92680
1962	108617	97.50	3.25	6.94	2787	2.50	11.52	2.21	111404
1963	112292	97.42	3.04	6.90	2971	2.58	6.32	2.46	115263
1964	161195	98.40	4.45	7.80	2629	1.60	8.48	3.40	163824
1965	90870	98.71	3.15	7.32	1190	1.29	10.26	3.20	92060
1966	95750	98.08	3.67	7.70	1871	1.92	10.69	2.55	97621
1967	115383	94.85	2.94	7.75	6262	5.15	8.84	2.04	121645
1968	103024	97.79	3.30	7.76	2328	2.21	10.68	2.42	105352
1969	86189	98.51	3.03	7.18	1304	1.49	4.04	2.26	87493
1970	124753	94.03	4.07	7.07	7926	5.97	12.06	2.34	132679
1971	132201	94.20	3.09	7.06	8021	5.72	16.14	2.08	140341
1972	121146	98.41	4.64	8.50	1953	1.59	13.47	2.49	123099
1973	94518	94.62	3.36	7.92	5369	5.38	10.49	2.53	99887
1974	67778	77.97	3.50	7.63	19145	22.03	18.22	2.30	86923
1975	73833	79.03	3.97	7.21	19591	20.97	11.80	2.32	93424
1976	79869	96.61	4.69	7.55	2802	3.39	10.53	2.59	82671
1977	90893	92.64	3.85	7.37	7222	7.36	9.20	2.70	98115
1978	54062	89.59	3.32	8.42	6280	10.41	5.03	2.83	60342
1979	51511	93.34	3.21	7.93	3675	6.66	4.06	2.48	55186
1980	39014	99.14	3.70	5.76	340	0.86	6.80	3.24	39354
1951-55	154662	99.74	2.42	7.71	364	0.25	9.02	5.33	155028
1956-60	139861	97.88	3.15	7.14	2865	2.12	11.48	2.74	142726
1961-65	112403	97.62	3.21	7.34	2643	2.38	9.09	2.75	115046
1966-70	105020	96.65	3.40	7.49	3938	3.35	9.26	2.32	108958
1971-75	97895	88.85	3.71	7.66	10816	11.13	14.02	2.34	108735
1976-80	63070	94.26	3.76	7.41	4064	5.74	7.12	2.77	67134
1951-80	112152	95.83	3.28	7.46	4115	4.16	10.00	3.04	116271

[a] Round (whole) weight.

[b] Dressed weight (gutted with head left on).

[c] Includes seine catches in 1954 (12 pieces) and in 1971 (119 pieces).

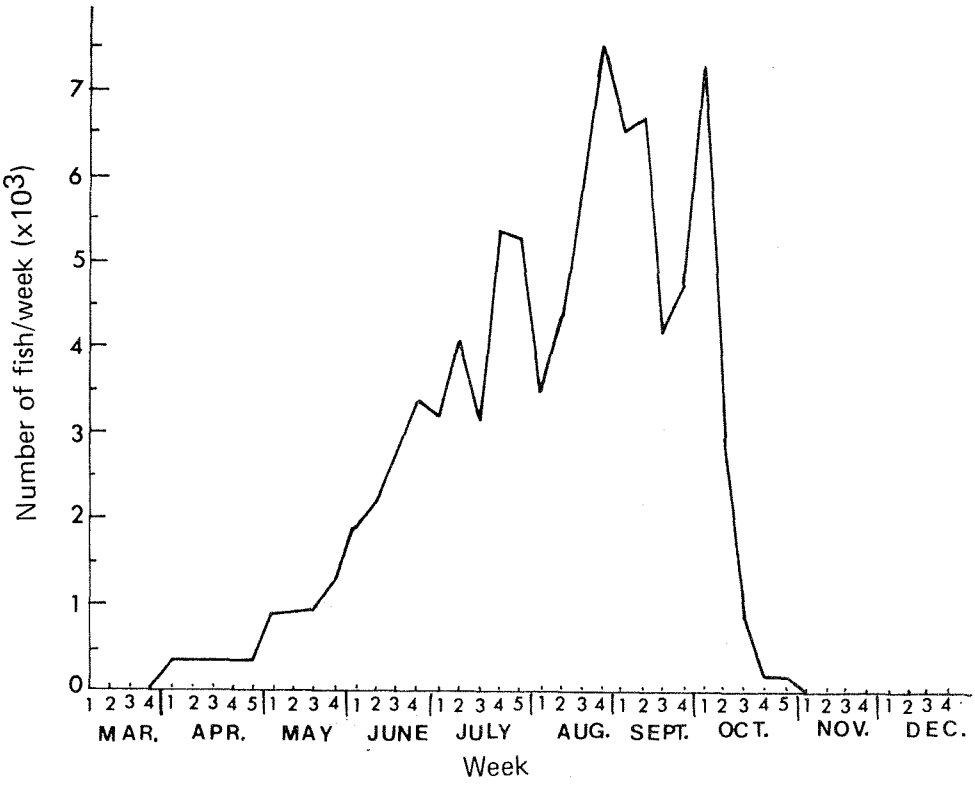


Fig. 17. Weekly chinook gillnet catch, Area 29, 1969-1978 mean data (weeks indicated are the standard statistical weeks used by the DFO).

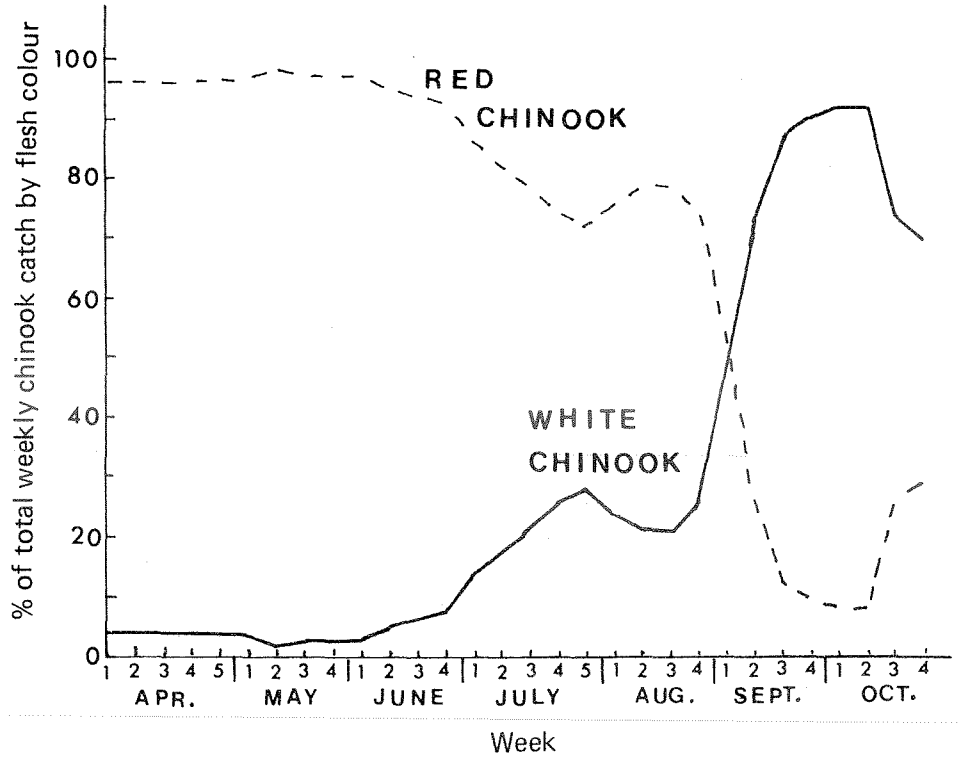


Fig. 18. Seasonal occurrence of red and white chinook in the gillnet fishery, Area 29, 1974-1978 weekly mean data (weeks indicated are the standard statistical weeks used by the DFO).

1970's) (Table 10) and declined to zero in 1981 when the early season fishery was closed. This decline is due to the reduction since the 1960's of the early season fishery. The middle season catches (July and August) declined the least since the 1950's (by 51%; from 59,000 fish to 29,000 fish by the late 1950's, five-year means); they contributed from 39% of the annual catch during the early 1950's, to 56% in the late 1960's, declining to 44% by late 1970's (Table 10). Despite the above fluctuations in July to August catch contributions, their absolute catches (five-year means) remained relatively stable until the 1970's (range: 55,000 - 59,000 fish), but dropped to 29,000 fish by the late 1970's (Table 10). Catches in 1980 and 1981 declined even further. The late season catches (September and October) declined by 60% since the 1950's (from 57,000 fish to 23,000 fish by the late 1970's); their contributions to the annual catch fell from 36% in the 1950's to 20% in the 1960's, but have since recovered to 37% (Table 10).

There have been also seasonal variations in catch per unit effort (CPUE) (i.e. catch per delivery). The 30-year mean CPUE was low until the end of May (approximately three fish, but four fish in 1976 to 1980); peaked in June to five and again in September to four fish; then dropped abruptly to one fish in October (Fig. 16, Append. 5). This seasonal trend in CPUE has been consistent over the period of record despite declines in total catch and deliveries, and despite mesh restriction applied since 1974. The annual CPUE during 1951 to 1980 (five-year means) increased from 2.4 to 3.8 fish (Table 9). However, the actual CPUE is probably somewhat higher since the sales slip records underestimate the total Fraser River catch, especially in the spring when a significant number of chinook are used for personal consumption or sold without being reported on sales slips.

The mean (1951 - 1980) landed weight per chinook also varied seasonally from a low of 6.1 kg before May, to a June peak of 7.9 kg, followed by a small decline in July and August, and an October high of 9.1 kg (Fig. 16, Append. 5). The above seasonal variation is attributed both to the population differences among fish and to mesh size of nets used. The large fish weights observed in the spring (June) may be due to targeting on these fish with larger mesh size nets.

Finally, there has been a seasonal variation in the proportion of red-and white-fleshed chinook in the gillnet catch. Red chinook dominate the catch up to the end of August (70% - 98% of total), although there is evidence of a small peak of white chinook near the end of July (Fig. 18). Beginning in early September, white chinook become the dominant group and remain so for the rest of the season.

The 30-year mean annual catch of red chinook is approximately twice that of white chinook, excluding jacks, (60,000 red vs. 37,000 white) (Table 11). During 1951 to 1980, the red chinook catches declined relatively less compared to white chinook (53% vs. 65%) and jack chinook (65%) (Table 11). The proportion of white chinook in the total gillnet catch decreased from 37% in the early 1950's to around 26% in the 1960's (Table 11). This parallels the decline observed in the September/October catches during the same period (Table 10), and may indicate an overexploitation of the white chinook stocks during the 1960's. These stocks have since recovered to their earlier relative proportion of approximately 35%.

Throughout the period of record, the white chinook weighed consistently more than the red chinook (mean 9.3 kg vs. 7.7 kg), although this gap is

Table 10. Chinook gillnet catch, percent of annual catch, and catch per delivery by season, Area 29, 1951-1980.

YEAR	START-JUNE[a] CATCH	START-JUNE % OF ANNUAL CATCH	START-JUNE CATCH PER DELIVERY	JULY-AUGUST CATCH	JULY-AUGUST % OF ANNUAL CATCH	JULY-AUGUST CATCH PER DELIVERY	SEPTEMBER-END[b] CATCH	SEPTEMBER-END % OF ANNUAL CATCH	SEPTEMBER-END CATCH PER DELIVERY
1951	46805	31.80	3.96	54478	37.01	1.73	45914	31.19	1.17
1952	52032	39.48	4.17	62126	47.14	2.07	17642	13.39	0.92
1953	43301	24.58	3.86	57781	32.80	1.88	75060	42.61	3.11
1954	28296	15.80	3.50	59206	33.06	2.89	91580	51.14	2.20
1955	25323	18.21	3.27	59225	42.58	3.08	54539	39.21	2.76
1956	35909	29.16	4.27	39304	31.92	2.43	47924	38.92	3.18
1957	26376	21.33	4.14	49279	39.86	3.05	47978	38.81	3.02
1958	42703	25.53	4.51	77862	46.54	3.51	46723	27.93	1.71
1959	40789	24.61	4.13	64700	39.04	4.09	60247	36.35	2.88
1960	24061	20.13	3.02	58550	48.99	2.86	36899	30.88	3.42
1961	27944	31.38	2.67	43662	49.04	1.84	17436	19.58	2.53
1962	33876	31.19	3.51	43778	40.30	3.54	30963	28.51	2.73
1963	47069	41.92	4.09	42070	37.46	3.07	23153	20.62	1.96
1964	39969	24.80	3.62	92935	57.65	6.02	28291	17.55	2.92
1965	22283	24.52	3.81	51552	56.73	2.86	17035	18.75	3.43
1966	17506	18.28	3.49	62319	65.09	3.89	15925	16.63	3.18
1967	30532	26.46	3.99	67856	58.81	3.30	16995	14.73	1.54
1968	23953	23.25	3.78	50833	49.34	3.40	28238	27.41	2.83
1969	28647	33.24	4.11	43697	50.70	3.05	13845	16.06	1.93
1970	21543	17.27	3.32	69310	55.56	5.64	33900	27.17	2.85
1971	26742	20.21	4.06	58715	44.37	3.25	46744	35.36	2.57
1972	14286	11.79	3.90	42246	34.87	3.58	64614	53.34	6.06
1973	11743	12.42	3.40	40723	43.08	2.67	42052	44.49	4.45
1974	11271	16.63	4.22	36536	53.91	3.77	19971	29.47	2.84
1975	10671	14.45	4.77	29629	40.13	4.41	33533	45.42	3.48
1976	11796	14.77	5.50	34881	43.67	4.79	33192	41.56	4.38
1977	13307	14.64	4.96	46057	50.67	3.20	31529	34.69	4.83
1978	12299	22.75	5.06	22373	41.38	4.20	19390	35.87	2.28
1979	18149	35.23	6.24	30928	60.04	2.61	2434	4.73	1.93
1980	3266	8.37	3.87	9495	24.34	2.00	26253	67.29	5.30
1951-55	39151	25.97	3.75	58563	38.52	2.33	56947	35.51	2.03
1956-60	33968	24.15	4.01	57939	41.27	3.19	47954	34.58	2.84
1961-65	34228	30.76	3.54	54799	48.24	3.47	23376	21.00	2.71
1966-70	24436	23.70	3.74	58803	55.90	3.86	21781	20.40	2.47
1971-75	14943	15.10	4.07	41570	43.27	3.54	41383	41.61	3.88
1976-80	11763	19.15	5.13	28747	44.02	3.36	22560	36.83	3.74
1951-80	26415	23.14	4.04	50070	45.20	3.29	35667	31.65	2.95

[a] See Append. 3 for starting dates.

[b] Chinook run is usually completed by end of October or early November; seine catches in 1954 (12 pieces) and 1971 (119 pieces) are included.

Table 11. Annual chinook gillnet catch of red, white and jack (both colours) chinook, percent of total catch, and mean fish weight per group, Area 29, 1951-1980.

	RED CHINOOK			WHITE CHINOOK			JACK CHINOOK [a]		
YEAR	CATCH	% OF TOTAL CATCH	MEAN WEIGHT (KG)	CATCH	% OF TOTAL CATCH	MEAN WEIGHT (KG)	CATCH	% OF TOTAL CATCH	MEAN WEIGHT (KG)
1951	75867	51.54	8.04	54055	36.72	9.44	17275	11.74	1.89
1952	86799	65.86	7.78	27395	20.79	8.77	17606	13.36	1.80
1953	80960	45.96	7.62	72345	41.07	9.99	22837	12.97	2.02
1954	67775	37.85	8.10	79577	44.44	10.76	31730	17.72	2.22
1955	60286	43.34	7.50	54983	39.53	9.57	23818	17.12	2.25
1956	59536	48.35	6.80	53171	43.18	10.19	10430	8.47	2.27
1957	46040	37.24	7.02	36441	29.48	7.85	41152	33.29	2.26
1958	86258	51.56	7.58	50466	30.17	8.80	30564	18.27	2.04
1959	79468	47.95	8.07	58162	35.09	9.60	28106	16.96	2.19
1960	62963	52.68	6.94	45816	38.34	9.78	10731	8.98	2.23
1961	53917	60.55	7.45	28502	32.01	9.72	6623	7.44	1.97
1962	59467	54.75	7.18	32689	30.10	8.97	16461	15.16	2.01
1963	72828	64.86	6.77	29766	26.51	8.74	9698	8.64	2.16
1964	94689	58.74	8.43	43028	26.69	9.45	23478	14.56	2.20
1965	51946	57.17	7.61	24692	27.17	9.67	14232	15.66	2.19
1966	61435	64.16	7.86	24393	25.48	9.53	9922	10.36	2.17
1967	77302	67.00	8.29	25851	22.40	8.75	12230	10.60	2.25
1968	56507	54.85	8.22	32660	31.70	9.32	13857	13.45	2.22
1969	56412	65.45	7.50	19566	22.70	8.86	10211	11.85	2.22
1970	72255	57.92	7.68	32703	26.21	8.92	19795	15.87	1.79
1971	73666	55.72	7.74	38302	28.97	8.61	20233	15.30	1.64
1972	54384	44.89	8.46	57397	47.38	9.61	9365	7.73	1.89
1973	43169	45.67	8.05	38213	40.43	9.86	13136	13.90	1.86
1974	41517	61.25	7.77	19865	29.31	9.22	6396	9.44	1.77
1975	37481	50.76	7.58	25493	34.53	8.93	10859	14.71	1.88
1976	40882	51.19	8.00	28239	35.36	9.11	10748	13.46	1.77
1977	49542	54.51	7.75	31450	34.60	8.57	9901	10.89	1.70
1978	30118	55.71	8.56	19129	35.38	9.90	4815	8.91	1.68
1979	41204	79.99	8.29	6676	12.96	9.03	3631	7.05	1.82
1980	12001	30.76	7.31	16694	42.79	7.34	10319	26.45	1.40
1951-55	74337	48.91	7.81	57671	36.51	9.71	22653	14.58	2.03
1956-60	66853	47.56	7.28	48811	35.25	9.25	24197	17.19	2.20
1961-65	66569	59.21	7.49	31735	28.50	9.31	14098	12.29	2.10
1966-70	64782	61.88	7.91	27035	25.70	9.08	13203	12.43	2.13
1971-75	50043	51.66	7.92	35854	36.12	9.25	11998	12.22	1.81
1976-80	34749	54.43	7.98	20438	32.22	8.79	7883	13.35	1.67
1951-80	59556	53.94	7.73	36924	32.38	9.23	15672	13.68	1.99

[a] "Jack" chinook are small (possibly immature) fish ranging from 1.4 kg to 2.5 kg; definition of a "jack" chinook probably varies from cannery to cannery and from year to year, since cannery workers separate the fish.

lessening (Table 11). Jack chinook of both flesh colours weigh approximately 2 kg but they have lost nearly one half a kilogram in mean weight over the last 30 years (Table 11). This may be due to a change in the "jack" classification system, as more of the larger individuals are being placed in the appropriate colour category of larger fish.

Chinook abundance index: Indices of salmon abundance in various terminal fisheries have been determined by the Department of Fisheries and Oceans by conducting regular test fisheries, such as those for chum salmon (Palmer 1972). A chinook test fishery was maintained on the Fraser River during 1964 to 1968, and was re-established in 1980.

An alternate approximate measure of chinook abundance and migration timing through the terminal fishery has been obtained by using actual catch data and boat counts during the fishery to obtain the mean catch per boat day (CPUE) during the first day of fishing in each week in Area 29D. This provides a continuous abundance index during the Fraser River gillnet fishery which, since 1964, has been generally opened regularly each week for one or two days (Append. 3). Complications in interpreting such data arise during the IPSFC control period (July to Sept./Oct.) when the weekly openings are less regular (Append. 3), as well as during the periods of mesh size regulations, imposed since 1974, in order to reduce chinook catch. Nevertheless, a few general conclusions can be made from the CPUE data (Fig. 19, Append. 6):

1. the abundance of chinook in the Fraser River (Area 29D) is generally low until the end of May;

2. a strong pulse of chinook passes through the fishery from the end of June to mid-July -- this is thought to be the bulk of the upper Fraser River stocks (i.e. those destined primarily for areas upstream of the Thompson River);

3. a weaker pulse of chinook passes through in the latter part of August -possibly the bulk of the Thompson River and particularly of Shuswap River fish; however, this pulse may be masked because of intensive targeting on sockeye;

4. a strong pulse of fish passes in the last week of September or the first week of October corresponding to the late arriving Harrison River stocks.

Chinook troll fishery, Area 29

The annual (five-year mean) troll landings of chinook in Area 29 increased from less than 400 fish in the early 1950's, to nearly 11,000 fish in the early 1970's, but declined to a mean of 4,000 fish in recent years (Table 9). The percent contribution of the troll fishery to the total Area 29 commercial catch of chinook also increased from less than 1% in the early 1950's to 11% in the early 1970's, followed by a decline to 6% in recent years (Table 9).

The annual CPUE (catch per boat day) was high throughout the 1951 to 1980 period, with a 30-year mean of 10 fish (Table 9), and is comparable to the CPUE reported for other parts of Georgia Strait and off the west coast of Vancouver Island (DFO, unpublished data). The mean annual (1951 - 1980)

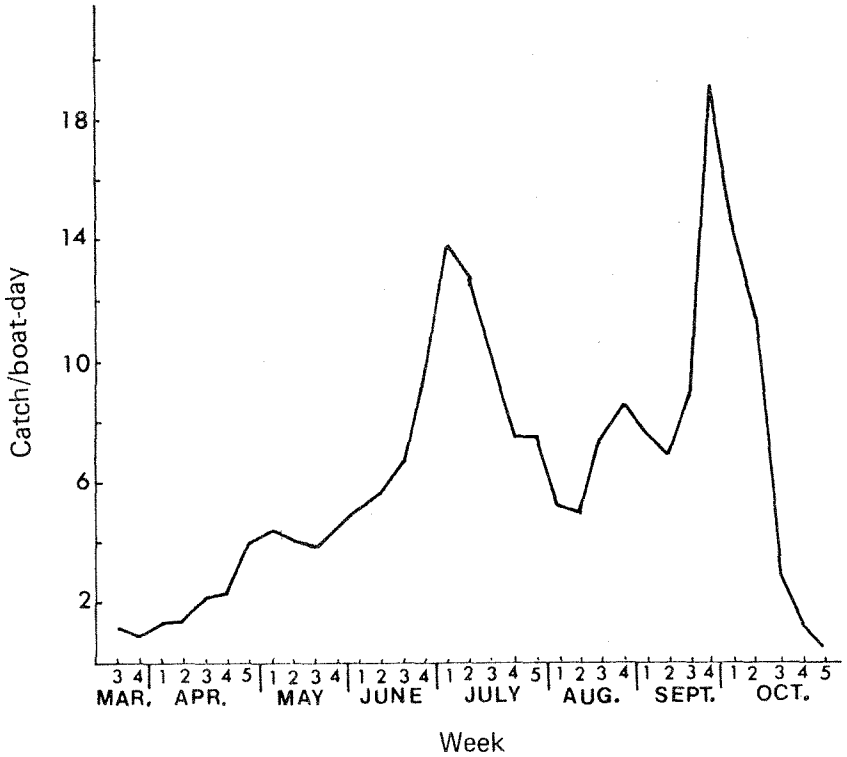


Fig. 19. Weekly indices of chinook abundance in Fraser River, as measured by catch per boat-day in Area 29D on the first day of fishing each week (1969-1978 mean data).

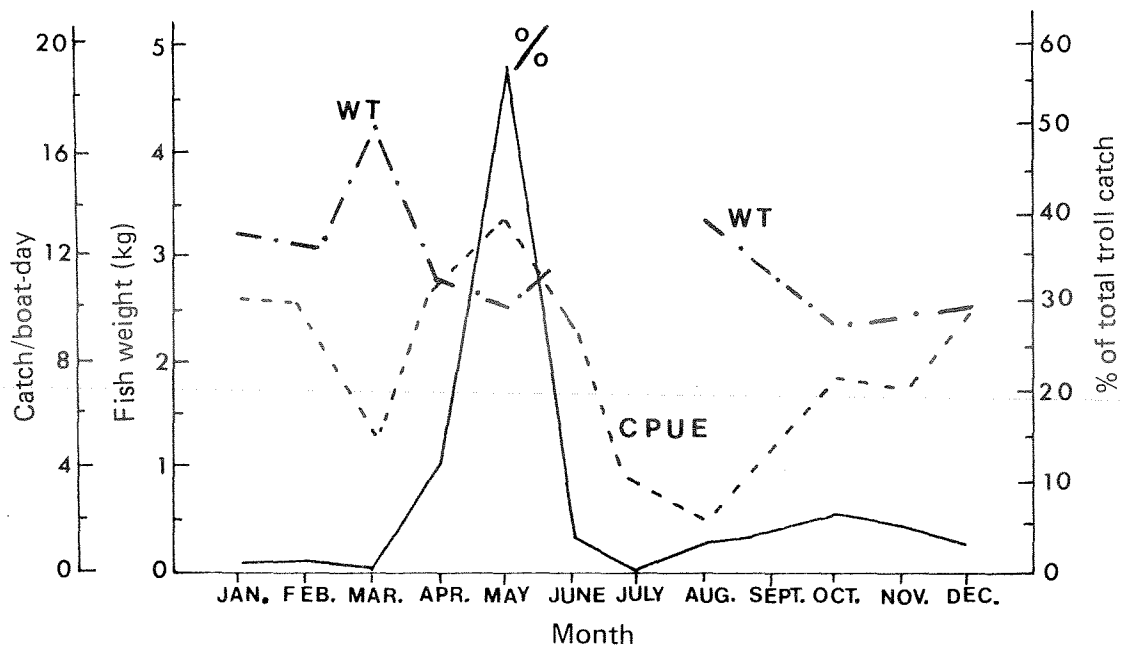


Fig. 20. Mean monthly landed (dressed) weight per fish, catch per boat-day (CPUE), and percent contribution per month of troll-caught chinook, Area 29, 1951-1980.

dressed weight of troll-caught chinook (3.0 kg) is approximately a third of the mean whole weight of gillnet-caught chinook (7.5 kg) (Table 9). Even after correcting for the dressed vs. whole weights, the large difference observed indicates that the troll fishery is exploiting an entirely different population of chinook (primarily immature, two and three-year-olds) compared to the gillnet fishery (mature three, four and five-year-olds).

Seasonal troll catch data reflect the regulatory changes in the length of the fishing season. Early landings (up to 1965) were concentrated in the fall and winter months (October to March), with the October to December period accounting for up to 64% of the annual troll catch (Append. 7). After 1965, when new regulations eliminated the winter troll fishery, most of the annual catch was made in the spring months, particularly in May when up to 80% of the annual troll landings were taken (Fig. 20, Append. 7).

The mean monthly (1951 - 1980) CPUE was highest in May (13 fish per boat-day), and lowest in July and August (2-3 fish per boat-day) (Fig. 20, Append. 7). The 30-year mean monthly weight of troll-caught chinook changed little seasonally (2.4 - 3.5 kg, but 4.3 kg in March) (Fig. 20, Append. 7). The occasional high mean weights, reported particularly in July, are probably due to the combined effect of low catches and rounding of figures made during weight reporting (Append. 7).

Chinook exploitation outside Area 29

The Fraser River chinook stocks nose tagged (CWT) during 1972 to 1979 are listed in Appendix 8. Preliminary adult recovery data from various offshore fisheries, although few in number, indicate the ocean distribution and direction of migration of some of the listed Fraser River stocks. In 1972, juveniles from a fall run of Harrison River chinook were tagged and released (incubation and rearing to smolt size carried out at the Capilano Hatchery in Burrard Inlet). Adult distribution, as indicated by recovered tags (Table 12) is probably somewhat biased since the mark-recovery program was only beginning at this time and was concentrated mainly in the Georgia Strait and off the west coast of Vancouver Island. Nevertheless, the data show that 44% of the total Harrison River catch was taken by the troll fishery, with over half that catch (28% of total) made on the west coast of Vancouver Island (Areas 21-24, & C); 25% of the total catch was taken by the Georgia Strait sport fishery; and 14% by the net fisheries (Table 12). The combined troll and sport fisheries in Georgia Strait accounted for 38% of the total catch of the Harrison River stock (Table 12).

The above distribution differed considerably from the tagging returns of the South Thompson River stocks (1975 brood), where few recoveries were made in both Georgia Strait and off the west coast of Vancouver Island (Table 13). Instead, the northern troll fisheries, especially in Alaska, accounted for 68% of the South Thompson River chinook catch returns (Table 13). A few miscellaneous recoveries from other Fraser up-river stocks (for example, Chilko and Deadman Rivers) indicate a similar pattern of exploitation.

Tag recoveries from Canadian hatchery-produced chinook also show a variable pattern of ocean distribution depending on the stock: Robertson Creek chinook (west coast of Vancouver Island) show exploitation of over 50% by Alaskan troll; Big Qualicum chinook (mid-east coast of Vancouver Island) are intermediate with 30% to 50% taken by the combined northern B.C. and Alaskan troll; and Capilano chinook (Burrard Inlet) are taken mainly in

Table 12. Estimated recoveries of coded wire tagged Harrison River chinook (1971 brood) from various west coast fisheries.[a]

Area of exploitation	AGE[b] 3 Estimated recoveries	3 % of Total	4 Estimated recoveries	4 % of Total	5 Estimated recoveries	5 % of Total	Total Estimated recoveries	Total % of Total
Southwest Troll (Areas 21-24,C)	27	14	36	17	0	--	63	28
Georgia St. Troll (Areas 13-18,29)	21	9	8	4	0	--	29	13
Northern Troll (Areas 1-5)	0	--	2	1	3	1	5	2
American Troll	0	--	1	< 0.5	0	--	1	< 0.5
Total Troll	48	22%	47	21%	3	1%	98	44%
Juan de Fuca Net (Area 20)	0	--	3	1	0	--	3	1
Johnstone St. Net (Areas 12,13)	0	--	5	2	0	--	5	2
American Net	0	--	1	< 0.5	3	1	4	2
Fraser River Net	0	--	18	8	0	--	18	8
Total Net	0	--	27	12%	3	1%	30	14%
Georgia St. Sport	32	14	24	11	0	--	56	25
Other	22	10	13	6	3	1	38	17
Total catch recoveries	102	46%	111	50%	9	4%	222	100%

[a] Recoveries adjusted for sampling rates; there were no spawning ground recoveries.
[b] Two-year olds were not included since mark recovery program was only intiated in 1973.

Table 13. Estimated recoveries of coded wire tagged Thompson River chinook (1975 brood) from various west coast fisheries.[a]

Area of exploitation	AGE 2 Estimated recoveries	2 % of total catch	3 Estimated recoveries	3 % of total catch	4 Estimated recoveries	4 % of total catch	5 Estimated recoveries	5 % of total catch	Total Estimated recoveries	Total % of total catch
Alaska Troll	0	--	4[b]	4	28[b]	30	8[b]	9	40[b]	43
Northern Troll (Areas 1-5	0	--	3	3	20	22	0	--	23	25
Central Troll (Areas 6-12)	0	--	2	2	2	2	0	--	4	4
West Coast Troll (Areas 23-27)	5	5	0	--	0	--	0	--	5	5
Johnstone St. Net (Area 13)	0	--	2	2	3	3	0	--	5	5
Point Roberts Net (Washington)	0	--	3	3	3[c]	3	0	--	6	6
Fraser River Net (Area 29)	0	--	2	2	3	3	0	--	5	5
Georgia St. Sport (Areas 13-19,18,19)	5[d]	5	0	--	0	--	0	--	5[d]	5
Total catch recoveries	10	11%	16	17%	59	63%	8	9%	93	100%
Spawners	0	--	0	--	85	--	0[b]	--	85	--
Total recoveries	10	--	16	--	144	--	8[b]	--	178	---

[a] Data sources: Washington State Dept. Fisheries; DFO (Mark Recovery Program); and Alaska Dept. Fish and Game. Recoveries adjusted for sampling rates; spawning ground recoveries estimated from marked-unmarked ratios seen on spawning grounds, multiplied by estimated total escapement; all data are preliminary.

[b] Estimated by a factor of 4 on the assumption that Alaska has an overall sampling rate of about 25%.

[c] Estimated by a factor of 3 based on the Washington State Dept. Fisheries 1978 report.

[d] Estimated by a factor of 5 based on pers. comm. with M. Barker (in charge of Georgia St. creel survey).

Georgia Strait (over 50%) (T. Perry, DFO, pers. comm.).

On the basis of the above data, it is suggested that the up-river summer runs of Fraser River stocks, such as the Thompson River chinook, behave differently from the lower river fall runs of stocks, such as the Harrison River chinook. The up-river stocks probably stay only briefly in Georgia Strait (as evidenced by lack of returns of two-year-olds from the Georgia Strait sport fishery), and instead move northward, maturing on the feeding grounds off the Queen Charlotte Islands and southeast Alaska. The lower river stocks, mainly from the Harrison system, may reside primarily in Georgia Strait, or move out to the west coast of Vancouver Island. Likewise, Cowichan River (Fig. 9) chinook, which seem to behave in a way similar to that of the Harrison River stocks, including a large fry outmigration to the estuary, appear to be harvested almost exclusively (over 80%) by the Georgia Strait sport and troll fisheries (based on recoveries from estuary-tagged juveniles) (Barnetson MS 1980). Therefore, given a good fry-to-adult survival of the lower Fraser River stocks, the massive chinook fry outmigration documented at Mission may be contributing significantly to the Georgia Strait wild chinook production and fishery harvest.

Based on the above evidence, it appears that the Fraser River chinook outside Area 29 are exploited most heavily by the mixed-stock troll fisheries and by the Georgia Strait sport fishery.

COHO

Coho trap fishery

During 1926 to 1934, Puget Sound traps accounted for only 22% of the overall mean annual catch of coho in the Puget Sound area and were similar to the troll catches made in that area (Table 14). Trap captures north of Deception Pass (Fig. 10) accounted for 37% of the total Puget Sound trap catch of coho (1915 -1934 data; Rounsefell and Kelez (1938)), with probably only a minor contribution made by Fraser River stocks, since many other coho populations utilize Georgia Strait. Catch data from the Sooke area show a strong decline over the period of record (1915 - 1958), probably the result of high exploitation rates (Figs. 13 & 14).

Coho gillnet fishery, Area 29

The annual (five-year mean) gillnet catch of coho salmon in Area 29 averaged 62,000 pieces in the last 30 years (or about half the mean annual catch of chinook (Table 9)), and declined by 69% since the early 1950's (from approximately 96,000 fish to 30,000 fish by the late 1970's) (Fig. 21, Table 15). The annual landings fluctuated considerably from a high of 133,000 fish in 1964 to a low of 8,000 fish in 1979 (Table 15). The number of sales slip deliveries also dropped by 75% during the last 30 years (similar to those of chinook) (Append. 9). The total annual (five-year mean) landed weight of coho declined by 75% (from 336,000 kg in the early 1950's to 84,000 kg in the late 1970's) (Append. 9), due in part to a drop in mean weight per fish from approximately 3.4 kg in the 1950's and 1960's to 2.8 kg in the late 1970's (Table 15).

The highest monthly contributions to the mean annual (1951 - 1980) coho gillnet catch were made during September and October (46% and 42%

Table 14. Summary of early coho fishery catch data for areas in and around Puget Sound (1926-1934 mean data).[a]

Type of fishery	Mean annual catch	% of Total
Traps		
Puget Sound	311,000	22%
Purse seine		
Puget Sound	290,000	20%
Juan de Fuca St.	298,000	21%
Troll		
Puget Sound	14,000	1%
Swiftsure Bank	304,000	21%
Gillnet		
Puget Sound Rivers	55,000	4%
Fraser River[b]	160,000	11%
Minor gear		
Puget Sound	4,000	< 0.5%
Annual total	1,435,000	100%

[a] From: Rounsefell and Kelez (1938).

[b] Fraser River catch converted from cases of canned fish; fish caught for purposes other than canning, not included.

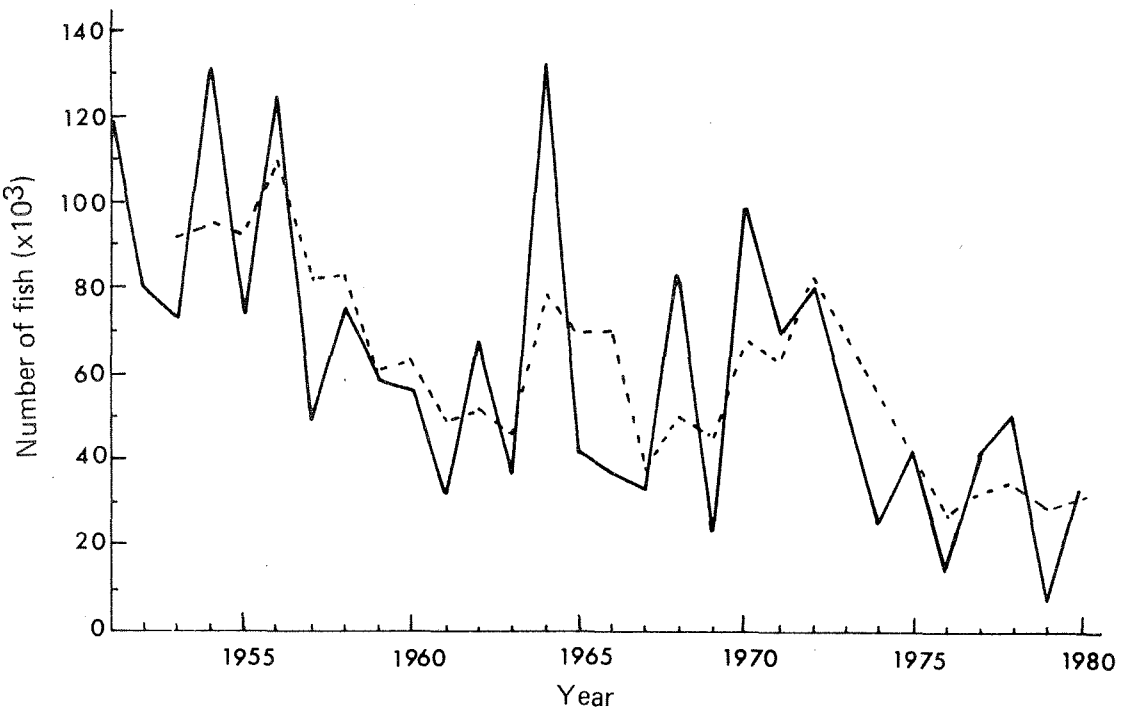


Fig. 21. Annual commercial gillnet catch of coho and three-year sliding average (dotted line), Area 29, 1951-1980.

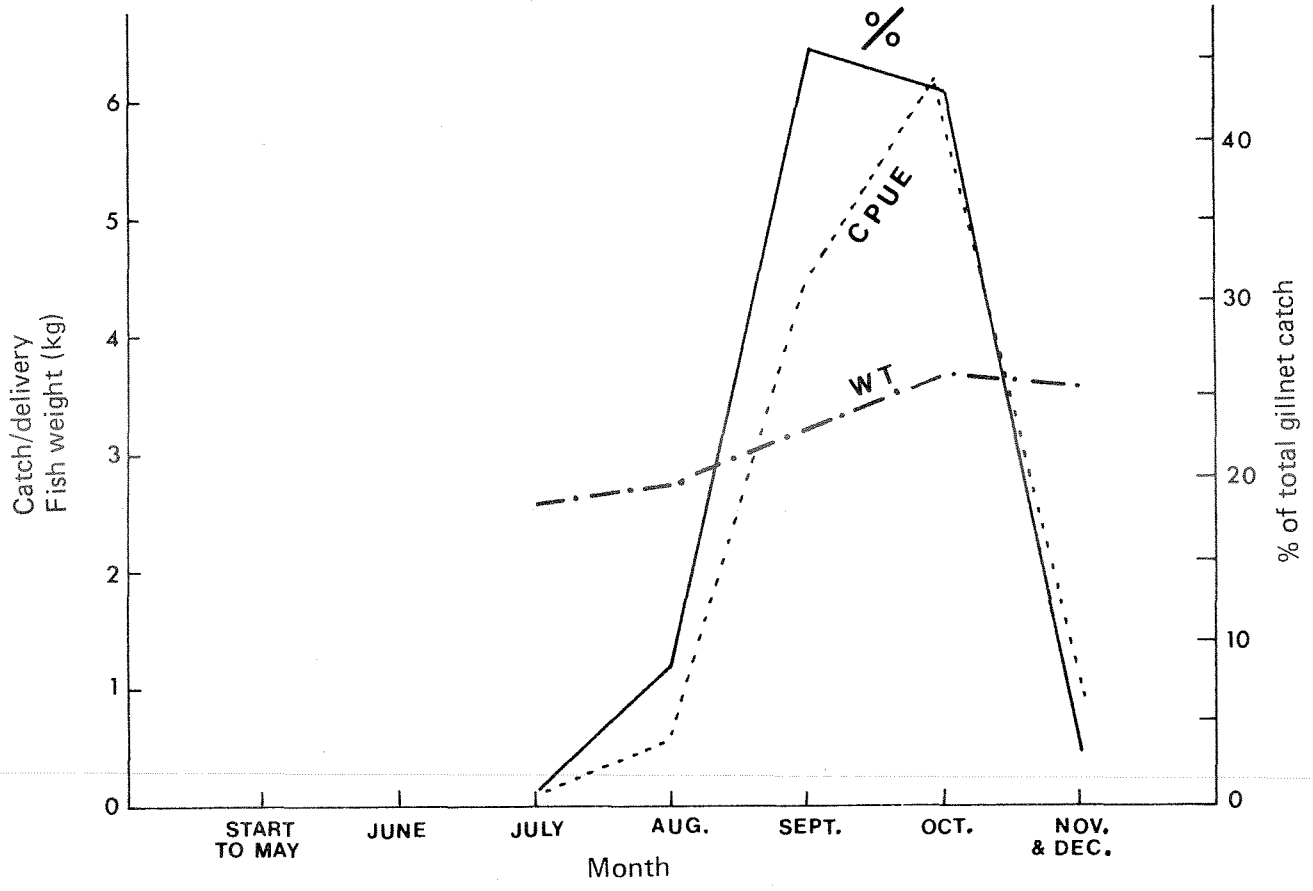


Fig. 22. Mean monthly landed (round) weight per fish, catch per delivery (CPUE), and percent contribution per month of gillnet-caught coho, Area 29, 1951-1980.

Table 15. Annual coho gillnet and troll catches, percent of total catch by gear type, catch per unit effort, and mean weight per fish, Area 29, 1951-1980.

YEAR	GILLNET				TROLL				TOTAL COMMERCIAL CATCH[e]
	CATCH	% OF TOTAL CATCH	CATCH PER DELIVERY[a]	MEAN WEIGHT PER FISH (KG)[b]	CATCH	% OF TOTAL CATCH	CATCH PER BOAT-DAY[c]	MEAN WEIGHT PER FISH (KG)[d]	
1951	123874	100.00	1.75	4.08	0	0.00	0.00	0.00	123874
1952	79846	99.99	1.62	3.42	8	0.01	4.00	0.00	79854
1953	73038	100.00	1.34	3.25	0	0.00	0.00	0.00	73038
1954	132063	99.80	2.29	3.29	133	0.10	26.60	1.02	132323
1955	73284	99.86	1.88	3.14	102	0.14	0.95	0.89	73386
1956	124669	99.99	3.99	3.73	12	0.01	0.11	3.78	124681
1957	48572	99.91	1.51	2.77	43	0.09	0.28	2.11	48615
1958	76290	99.99	1.54	3.35	6	0.01	0.07	0.00	76296
1959	58749	99.95	1.60	2.94	27	0.05	0.14	1.68	58776
1960	56342	99.13	1.80	3.37	492	0.87	1.45	1.57	56834
1961	32046	99.20	1.05	3.70	260	0.80	0.86	2.09	32306
1962	67993	99.91	2.87	3.64	60	0.09	0.28	1.51	68053
1963	35932	99.50	1.41	3.15	179	0.50	0.47	2.28	36111
1964	132712	99.96	5.28	3.73	51	0.04	0.64	2.67	132763
1965	42031	99.96	1.83	3.48	18	0.04	0.40	2.52	42049
1966	37094	99.93	1.76	3.20	27	0.07	0.38	1.68	37121
1967	33466	99.35	1.06	2.96	219	0.65	0.46	1.66	33685
1968	81973	99.97	3.29	2.87	24	0.03	0.52	1.89	81997
1969	22870	99.40	1.06	3.71	139	0.60	0.53	2.28	23009
1970	99085	99.56	4.10	3.94	434	0.44	3.65	1.88	99519
1971	69527	98.66	1.92	2.73	801	1.14	3.64	1.87	70473
1972	80923	99.78	3.60	3.28	175	0.22	3.65	1.81	81098
1973	53550	99.77	2.17	3.56	122	0.23	0.63	3.72	53672
1974	26176	98.31	1.57	3.19	450	1.69	1.23	3.02	26626
1975	43242	97.48	2.65	3.28	1119	2.52	1.74	2.84	44361
1976	14145	98.78	0.95	2.79	174	1.22	1.21	2.61	14319
1977	42230	94.55	2.02	2.48	2434	5.45	4.66	2.05	44664
1978	51021	91.38	3.69	3.09	4813	8.62	4.69	2.76	55834
1979	7710	82.50	0.54	2.79	1635	17.50	2.32	2.26	9345
1980	33342	99.70	3.17	2.94	101	0.30	4.39	1.98	33443
1951-55	96421	99.93	1.78	3.44	49	0.05	6.31	0.38	96495
1956-60	72924	99.80	2.09	3.23	116	0.20	0.41	1.83	73040
1961-65	62143	99.71	2.49	3.54	114	0.29	0.53	2.21	62256
1966-70	54898	99.64	2.26	3.34	169	0.36	1.11	1.88	55066
1971-75	54684	98.80	2.38	3.21	533	1.16	2.18	2.65	55246
1976-80	29690	93.38	2.07	2.82	1831	6.62	3.45	2.33	31521
1951-80	61793	98.54	2.18	3.26	469	1.45	2.33	1.88	62271

[a] Total deliveries after June 30 are used.
[b] Round (whole) weight.
[c] Total boat-days after May 31 are used.
[d] Dressed weight (gutted with head left on).
[e] Includes seine catches in 1954 and 1971.

respectively; Fig. 22, Append. 10). Landings for these two months were high throughout the period of record, but the October catch declined in the last five years to 8,000 pieces or 26% of the annual total (Append. 10), probably largely due to fewer October openings (Append. 3). August catch contributions ranged from 4% to 12% of the annual total, with a decline in the 1960's and 1970's possibly due to elimination of coho stocks coincident with peak sockeye migration. November catch contribution declined from 5% to 0.3% of the annual total largely due to earlier closing dates (Append. 3). Combined June and July catches were negligible at all times (about 1% of annual total) (Fig. 22, Append. 10). The above seasonal trend is detailed in the weekly 1969 to 1978 catch data where landings were low until the fourth week of August (<500 fish/week)), peaked abruptly to over 7,000 fish in the second week of September and first half of October, then tapered off, becoming negligible in November (Fig. 23).

The 30-year mean seasonal catch per delivery (CPUE) was highest during the months of greatest landings, i.e. September and October (4.5 and 6.2 fish/delivery respectively), with less than one fish per delivery usually reported for the remaining months (Fig. 22, Append. 10). The highest historical monthly CPUE was recorded during the 1970's when the October values exceeded eight fish per delivery (Append. 10). The overall annual (five-year mean) CPUE for coho remained relatively steady at about two fish per delivery since the 1950's (Table 15).

The mean landed weight per coho (1951 - 1980) shows a small seasonal increase from 2.6 kg in July to 3.6 kg in October (Fig. 22, Append. 10). This increase occurs consistently over the period of record and might be attributed to seasonal growth, population differences among fish, and mesh size of nets used (i.e. smaller "sockeye nets" substituted for larger "chum nets" later in the season.

Coho abundance index: The index of coho abundance in the Fraser River terminal fishery, as indicated by mean catch per boat-day during the first day of fishing each week in Area 29D (Append. 11), is incomplete due to the intermittent nature of the late fall gillnet fishery in the last decade (Append. 3). However, the available data suggest that coho do not become abundant in the terminal fishery until early September (Fig. 24). Also, at least two major peaks can be distinguished: one in early September - probably the bulk of the up-river stocks above Hope (for example, Thompson River) and a second, stronger peak in October -probably the bulk of the lower river stocks below Hope (Fig. 24, Append. 11). This interpretation agrees with the escapement estimates which indicate an up-river to lower river coho stock ratio of about 1:2 (Fig. 6).

Returns from the tagging of Chilliwack River juvenile coho (1974 and 1975 broods) were inconclusive regarding their abundance and timing in the terminal fishery. Of the total exploitation on the 1974 brood, the 1977 Fraser River gillnet fishery accounted for less than 0.5%, and the single actual tag recovery was made in the last week of July (Table 16). Of the total exploitation on the 1975 brood, the 1978 Fraser River gillnet fishery accounted for only 1.4%, with 90% of the tag recoveries made during October. This apparently low exploitation rate of Fraser River coho in the terminal gillnet fishery during the 1970's compared to earlier years (Table 15), is largely due to fewer openings designed to protect weak chum runs (Append. 3).

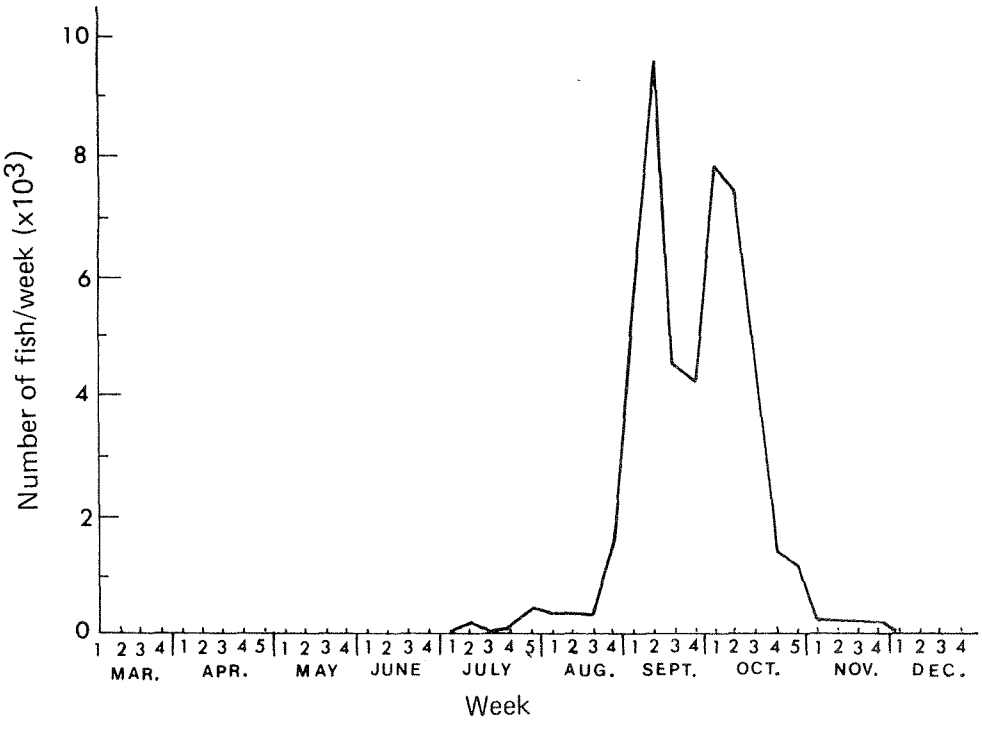


Fig. 23. Weekly coho gillnet catch, Area 29, 1969-1978 mean data (weeks indicated are the standard statistical weeks used by the DFO).

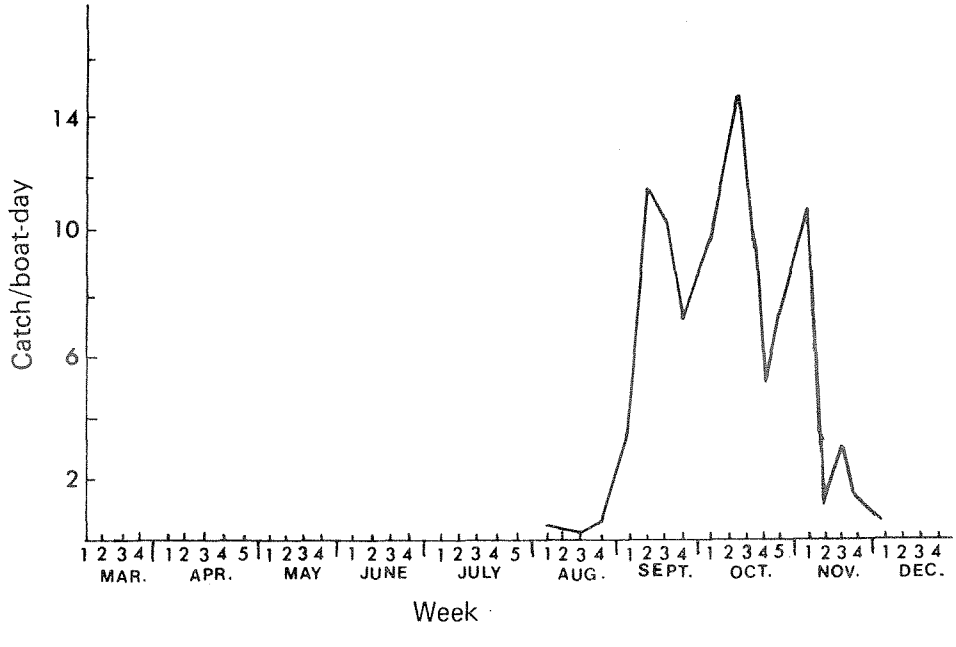


Fig. 24. Weekly indices of coho abundance in the Fraser River, as measured by catch per boat-day in Area 29D on the first day of fishing each week (1969-1978 mean data).

Coho troll fishery, Area 29

The coho troll fishery off the mouth of Fraser River is insignificant, mostly harvesting Capilano hatchery coho in recent years. Until 1974, the annual troll landings of coho in Area 29 were less than 1,000 fish, or less than 1% of the Area's total annual commercial catch of coho (Table 15). Only the 1977 to 1979 troll catches, ranging from 1,600 to 4,800 fish per year, contributed over 5% to the total annual commercial catch (Table 15). The mean annual (1951 - 1980) troll catch per boat-day (CPUE) was relatively low for coho (2.3 fish, Table 15) compared to chinook (10 fish, Table 9), and is lower than the CPUE reported for the coho troll fisheries in Georgia Strait and off the west coast of Vancouver Island (DFO, unpublished data).

The mean (1951 - 1980) landed weight of troll-caught coho is somewhat smaller than that of gillnet-caught fish (2.2 kg vs. 3.3 kg respectively) (Table 15), but the discrepancy between the two fisheries is not as great as that observed with chinook.

Seasonally, most coho troll catches are made in August and September (nearly 75% combined) (Fig. 25, Append. 12), which indicates that the troll fishery is exploiting the returning coho spawners, as does the gillnet fishery which has a similar seasonal catch pattern (Fig. 22). Catch per boat-day is highest in July (1951 - 1980 mean of 6.2 fish) with the highest historical value reported in July of 1976 to 1980 (17.0 fish per boat-day) (Fig. 25, Append. 12). Due to limited data, no seasonal trend in weight per fish could be discerned.

Coho exploitation outside Area 29

The Fraser River coho stocks which have been coded wire tagged during 1976 to 1979, are listed in Appendix 13. As with chinook, much of the adult data have yet to be collected and analyzed. However, the returns of the 1974 and 1975 brood year Chilliwack River stocks are complete and show the relative magnitude of this stock's exploitation by the various fisheries (Table 16). The returns were essentially similar for the two brood years since in both cases just over 40% of the catch was made by troll, while 20% (1974 brood) and 29% (1975 brood) were made by the Georgia Strait sport fishery. However, the 1975 brood fish apparently reared more locally compared to the 1974 brood. The 1975 brood was exploited largely in Georgia Strait (troll and sport catch - 60% of total), compared to only 35% for the 1974 brood. Instead, the 1974 brood had a far larger percentage taken on the west coast of Vancouver Island (Areas 21-27) (20%) compared to only 8% for the 1975 brood. The interception net fisheries in Johnstone and Juan de Fuca Straits contributed 11% to the exploitation of the 1974 brood, compared to only 4% for the 1975 bvrood, indicating a larger exploitation on returning outside coho, compared to the probably more locally rearing 1975 brood fish. Total exploitation was 87% on the 1974 brood, and 82% on the 1975 brood. The greater tag returns from the 1978 Georgia Strait troll fishery (1,154 tags from 1975 brood) compared to the 1977 fishery (628 tags from 1974 brood) (Table 16) may be explained by the larger total coho catch in 1978 (369,000 fish) compared to 1977 (195,000) (DFO Catch Statistics). However, it is likely that the two brood years of Chilliwack River coho had real differences in their residency patterns in Georgia Strait. This is so because troll exploitation rates appear to be relatively constant, and increased troll catches should indicate increased fish abundance in the area fished (K. Pitre, DFO, pers. comm.).

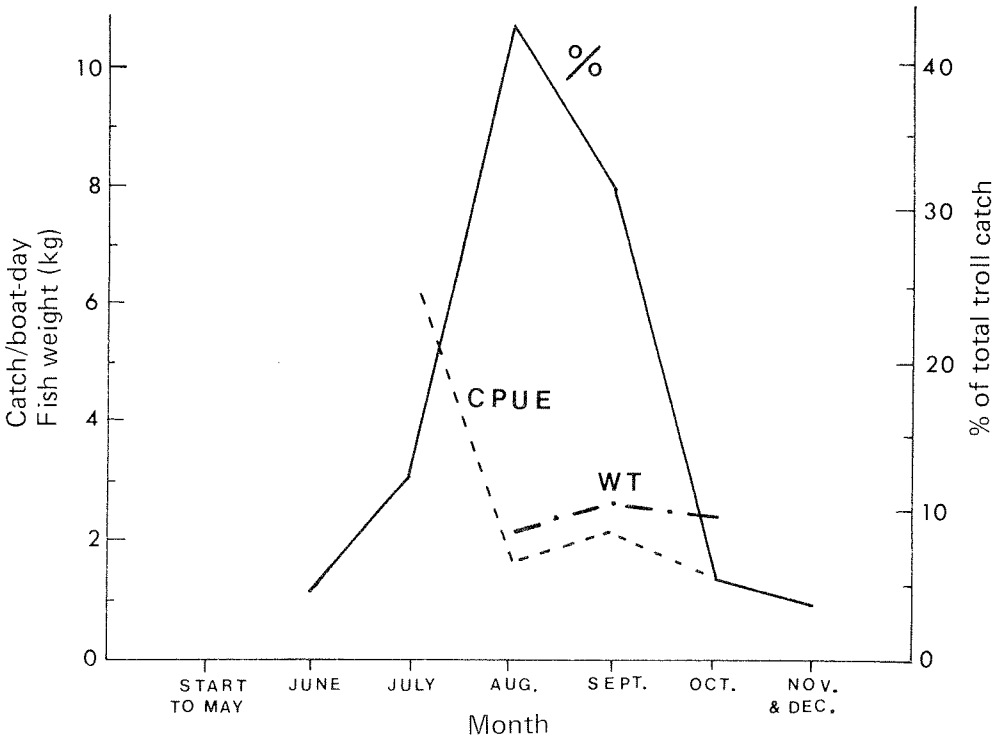


Fig. 25. Mean monthly landed (dressed) weight per fish, catch per day (CPUE), and percent contribution per month of troll-caught coho, Area 29, 1951-1980.

Fig. 26. Bar fishing on lower Fraser River (Vancouver Public Library, Negative No. 38453).

Table 16. Estimated recoveries of coded wire tagged Chilliwack River coho (1974 and 1975 broods) from various west coast fisheries.[a]

Area of exploitation	1974 BROOD[b] Estimated recoveries	% of Catch	% of Total recoveries	1975 BROOD[c] Estimated recoveries	% of Catch	% of Total recoveries
Central Troll (Areas 6-12)	22	1	< 0.5	39	1	1
Northwest Troll (Areas 25-27)	72	2	2	49	1	1
Southwest Troll (Areas 21-24,C)	761	18	16	279	7	6
Georgia St. Troll (Areas 13-18,29)	628	15	13	1154	31	25
American Troll	245	6	5	115	3	2
Total Troll	1728	42%	36%	1636	43%	35%
Central Net (Areas 1-11)	32	1	1	--		
Johnstone St. Net (Areas 12-12)	171	4	4	76	2	2
Juan de Fuca Net (Areas 18,20)	297	7	6	64	2	1
Fraser River Net (Area 29)	9	< 0.5	< 0.5	54	1	1
American Net	418	10%	9%	262	7%	6%
Total Net	927	22	19	456	12	10
Georgia St. Sport	827	20	17	1098	29	24
American Sport	98	2	2	101	3	2
Freshwater Sport[d]	200	5	4	130	3	3
Total Sport	1125	27%	24%	1329	35%	29%
Native Catch[d]	273	7	6	358	9	8
Other	94	2	2	23	1	< 0.5
Total Exploitation	4147	100%	87%	3802	100%	82%
Spawners	630	--	13%	829	--	18%
Total	4777			4631		
Catch/escapement ratio	6.6/1			4.6/1		
Number tags applied	19600			21580		
Estimated smolt-to-adult survival rate to the fishery	24%			21%		

[a] Recoveries adjusted for sampling rates; spawning ground recoveries estimated from marked-unmarked ratios seen on spawning grounds, multiplied by estimated total escapements; all data are preliminary.

[b] 0.4% of this brood recovered as two-year olds and 0.3% recovered as four-year olds (all recovered in Georgia Strait sport fishery).

[c] 0.8% of this brood recovered as two-year olds, and 0.4% recovered as four-year olds (most recovered in Georgia Strait sport fishery).

[d] Indian catch and freshwater sport catch of Chilliwack coho estimated by multiplying the respective total Fraser River catches by the proportion of Chilliwack spawners in the total Fraser escapement; mark-unmark ratio is assumed to be the same as seen on spawning grounds.

Examination of tag returns from Canadian hatchery-produced coho shows a pattern of exploitation similar to that of the above wild Chilliwack River stocks. The majority of harvest of the Georgia Strait hatchery coho is made by the west coast troll and by the Georgia Strait sport and troll fisheries (T. Perry, DFO, pers. comm.).

SPORT FISHERY

General description

Fraser River: The sport catches on the Fraser River consist primarily of bar fishing in the lower reaches below Hope and in several areas of the mid-Fraser and Thompson Rivers (Fig. 26). The majority of catch occurs below Hope (Fig. 1) near population centres. Fisheries Officers compile sport catch statistics but these are considered incomplete, mainly due to insufficient staff for proper censusing, and the data generally serve only as indicators of the magnitude of total catch. Although some of these estimates may be high, most are probably too low (Argue et al. 1977; Argue et al. 1982).

Georgia Strait: The complexity of Georgia Strait sport fishery deserves a separate study (Argue et al. 1982). Analyses of creek census and of coded wire tag returns from sport fishermen indicate that the sport catch statistics, published by the Department of Fisheries and Oceans (1953 - 1976), probably underestimate the true catch and effort (Argue et al. 1977). These authors suggested that the magnitude of the underestimate is approximately 60%, but more recent data indicate that an even higher correction factor may be needed (S. Heizer, DFO, pers. comm.). Fisheries managers agree, however, that the sport exploitation of chinook and coho in Georgia Strait is very high (probably at least twice the present troll exploitation) and that it is increasing every year.

Chinook sport fishery

Fraser River: The estimated annual sport catch of chinook in the Fraser River from 1969 to 1980 averaged 13,000 fish (range: 7,000 - 23,000) (Table 17). This constitutes about 7% of the mean annual (1969 - 1980) chinook return to the Fraser River (Table 22). Over 70% of the total sport catch is taken in the lower Fraser River below Hope, with an estimated mean annual catch of 11,000 fish (Table 17). The largest catch in this area occurs above Mission in the Chilliwack sub-district (6,000 fish). Only 14% of the total catch below Hope is taken as adults, the remainder being jacks and grilse (Table 17).

The major up-river sport catches of chinook are made at the Bridge River Rapids just upstream from Lillooet and in the lower Thompson River, between Lytton and Kamloops Lake (Fig. 1, Table 17). Other up-river areas of heavy chinook sport fishing, such as the South Thompson River at Chase and the Shuswap River (Fig. 1), have been closed to sport fishing during the spawning season. Since 1980, due to declining chinook stocks, all sport fishing for chinook was eliminated above Boston Bar (Fig. 1). Between Boston Bar and Oak St. Bridge (Fig. 2) sport fishermen must release all chinook larger than 50 cm in fork length.

Georgia Strait: It is believed that the Georgia Strait sport fishery is the largest single source of exploitation of Fraser River chinook, especially of late run or fall chinook (conclusive data are not available). Modeling of

Table 17. Estimated chinook catches in major Fraser River sport fisheries, 1969-1980.[a]

Year	Fraser River below Hope							Fraser River above Hope					Total
	Bar fishery below Mission[b]			Bar fishery above Mission				Fraser River		Thompson River			
				North side[e]		South side[f]							
	Adults	Jacks[c]	Grilse[d]	Adults	Jacks	Adults	Jacks	Near Lillooet[g]	Chilcotin River	Lower Thompson River[h]	Clearwater River	South Thompson River[i]	
1969	25	475	900	50	--[j]	1,500	6,500	1,500	--	1,850	--	--	12,800
1970	275	1,500	2,875	300	--	2,200	10,000	1,500	--	3,800	--	630	23,080
1971	169	2,942	352	300	500	1,520	8,000	2,000	--	3,000	--	345	19,128
1972	330	4,853	104	500	1,200	1,020	7,000	1,500	--	2,900	--	295	19,702
1973	102	2,590	149	600	2,300	270	--	2,000	--	2,900	50	645	11,606
1974	43	337	66	725	2,425	350	--	1,200	--	2,000	45	485	7,676
1975	45	1,488	--	700	3,000	360	--	3,000	100	3,000	20	515	12,228
1976	3,279	2,409	1,974	350	1,000	210	--	800	175	1,200	300	40	11,737
1977	246	801	2,640	200	2,500	200	--	650	100	800	75	800	9,012
1978	182	619	1,307	500	3,500	100	--	1,200	200	950	25	470	9,053
1979	485	1,400	--	115	350	150	500	900	300	1,600	0[k]	900[l]	6,700
1980	--	350	--	7	315	--	300	--	--	--	0	--	--
Mean[m]	471	1,647	1,152	362	1,709	716	5,383	1,477	175	2,182	64	513	12,975[n]
%of Total[o]	3.0	10.4	7.3	2.3	10.8	4.5	34.0	9.3	1.1	13.8	0.4	3.2	(15,851)[o]

[a] Data compiled from various Annual Narrative Reports (DFO, File No. 5871-BC1-1) and from Fisheries Officers (pers. comm.); data not adjusted with awareness factors.

[b] Areas 29B and 29D; data from Salmon Sport Fishing Catch Statistics, published annually by DFO; 1977-1980 data are preliminary.

[c] From 1.4 kg to 2.3 kg.

[d] Less than 1.4 kg and longer than 30 cm (nose-fork length).

[e] Mission-Harrison sub-district.

[f] Chilliwack sub-disrict.

[g] Most are taken near mouth of Bridge River; others at mouths of other major tributaries (e.g. Stein R., Nahatlatch R.).

[h] From Lytton to Kamloops Lake.

[i] Chase riffle on the South Thompson River and on the Shuswap River.

[j] No data available.

[k] Closed above Barriere River.

[l] 500 jacks.

[m] Only for years with recorded data.

[n] 11-year mean.

[o] The total (15,851) is sum of horizontal column means.

coded wire tag returns and presumed stock compositions, estimated that a total catch of over 100,000 Fraser River chinook is made annually in the Georgia Strait sport fishery. In support of this approximation, the Georgia Strait sport fishery was estimated to remove 25% of the Harrison River wild stocks (1971 brood year, Table 12), over 50% of the Capilano hatchery chinook (1971 - 1973 brood years), and nearly 40% of the Big Qualicum hatchery chinook (1971 - 1974 brood years) (T. Perry, pers. comm.).

Coho sport fishery

Fraser River: The estimated annual sport catch of coho in the Fraser River from 1969 to 1980 averaged 7,000 fish (range: 3,000 - 14,000) (Table 18). This constitutes about 5% of the mean annual (1968 - 1980) coho return to the Fraser River during that period (Table 23). Although the above catch is only about half the chinook sport catch, it still represents a significant exploitation of the coho returning to the Fraser River.

As with chinook, most of the total coho sport catch (>90%) is taken in the lower Fraser River below Hope, with an estimated mean annual catch there of 6,500 fish (Table 18). A major intensive winter sport fishery occurs on the Chilliwack River with mean catch per year estimated by the Fishery Officers at just over 1,000 coho (Table 18). Other estimates, however, are double or triple that amount (Meyer 1976). A 1979 weekend derby produced an estimated catch in that area of several hundred fish (F. Hellmer, local fisherman, pers. comm.). The sport catch on coho above Hope is limited, and occurs mainly near Lillooet and on the Thompson River (Fig. 1, Table 18). Year round and seasonal closures on the coho sport fishery occur in many areas of the Fraser River system.

Georgia Strait: The Georgia Strait sport fishery is estimated to harvest annually about 15% to 30% of the overall catch of Fraser River coho. In support of this approximation, the Georgia Strait sport fishery was estimated to remove 20% and 29% of the 1974 and 1975 Chilliwack River coho broods respectively (Table 16). This fishery also removes a high proportion of the Canadian hatchery-produced coho (mean >35%, range 22%-56%) (T. Perry, pers. comm.).

INDIAN FOOD FISHERY

General description

Indian fish food licences are issued to status Indians wishing to fish for salmon for personal use. Gear includes gaffs, spears, dip nets and set nets (Fig. 27). Favoured fishing locations often include partial river obstructions where the fish are forced to hold in slack water and are consequently crowded in high densities. Salmon are often preserved by traditional methods, such as drying or smoking, although many native people prefer canning and freezing (Bennett 1973). The main target species of the native people is usually sockeye, but many chinook and coho are also taken.

The enumeration of the Indian harvest is made by the Fisheries Officers and is subject to possible error since the manpower requirements for accurate monitoring of the total Indian fishery are not available. In addition, the catches may be under-reported and in some cases the fish are probably sold illegally.

Table 18. Estimated coho catches in major Fraser River sport fisheries, 1969-1980.[a]

Year	Fraser River below Hope					Fraser River above Hope		Total
	Bar fishery below Mission[b]		Bar fishery above Mission		Chilliwack River	Fraser River Near Lillooet[f]	Thompson River[g]	
	Adults	Grilse[c]	North side[d]	South side[e]				
1969	450	1,175	--[h]	3,000	--	--	250	4,875
1970	2,975	5,500	500	2,500	2,000	100	500	14,075
1971	757	160	500	3,000	3,000	150	500	8,067
1972	216	525	300	500	1,200	100	350	3,191
1973	62	1,075	350	150	600	100	400	2,737
1974	708	1,460	475	200	700	100	250	3,893
1975	541	800	400	220	1,100	0	200	3,261
1976	2,256	8,275	700	150	400	--	--	11,781
1977	3,333	6,466	600	100	650	--	--	11,149
1978	1,400	405	2,000	60	800	--	--	4,665
1979	3,230	--	300	100	600	--	--	4,230
1980	--	--	74	100	350	--	--	--
Mean[i]	1,448	2,584	564	840	1,036	92	350	6,539[j]
% of Total[k]	20.9	37.4	8.2	12.1	15.0	1.3	5.1	(6,914)[k]

[a] See Table 17, footnote "a" (but File No.5871-BC 1-1 and 2).
[b] See Table 17, footnote "b".
[c] Less than 1.4 kg and longer than 30 cm (nose-fork length).
[d] Mission-Harrison sub-district.
[e] Chilliwack sub-district.
[f] Mouths of various tributaries, Fraser Canyon to Bridge River.
[g] Most taken from Lytton to Kamloops Lake.
[h] No data available.
[i] Only for years with recorded data.
[j] 11-year mean.
[k] The total (6,914) is sum of horizontal column means.

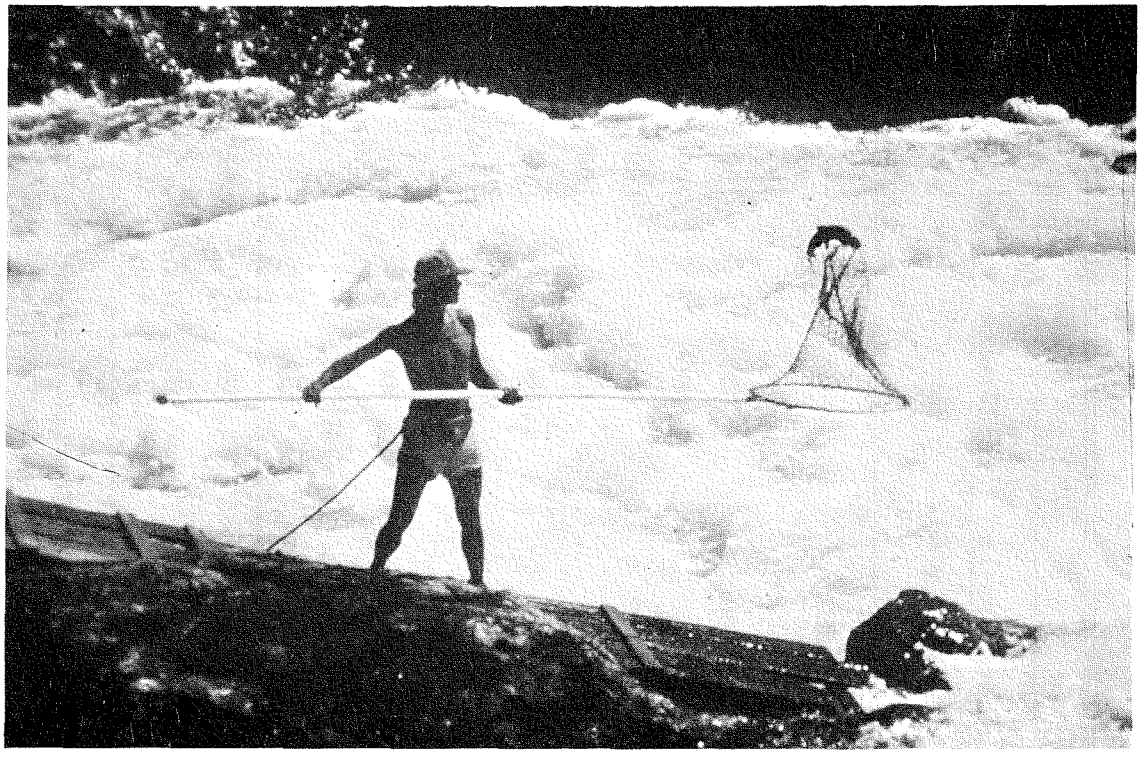


Fig. 27. Dip net fishing for salmon.

Chinook

It is estimated that a minimum of 17,000 to 20,000 chinook are taken annually by the Indian food fishery in the Fraser River (Table 19). This constitutes about 11% of the mean annual (1969 - 1980) chinook return to the Fraser River (Table 22). The majority of the fish (84%) are caught below Boston Bar (Fig. 1). Important fishing locations are the bars below Hope, the Fraser Canyon, and the Bridge River Rapids just upstream from Lillooet (Fig. 1).

Coho

It is estimated that over 20,000 coho are taken annually by the Indian food fishery in the Fraser River (Table 19). This also is probably a minimum estimate and constitutes about 16% of the mean annual (1969 - 1980) coho return to the Fraser River (Table 23). Almost all the fish (96%) are taken in the area downstream from Boston Bar and the important fishing locations are similar to those for chinook (except for the Bridge River Rapids).

ESCAPEMENTS

Escapement statistics are summarized for the period 1951 to 1980, and are taken largely from the spawning files maintained by the Department of Fisheries and Oceans which are updated annually by local Fisheries Officers. These data are supplemented by data compiled by the biological staff of the Department of Fisheries and Oceans and others.

Although much of our knowledge of the status of Fraser River chinook and coho stocks comes from annual visual assessments of the escapements, the methodology for collecting these data is not consistent from area to area, and is subject to a variable sampling bias. Generally, a Fishery Officer or patrolman periodically inspects a stream at different stages of the spawning cycle and at major spawning sites. This is usually done on foot, although boats, and more recently aircraft, are often used to augment the area covered. In some cases, the collected data are unreliable due to insufficient manpower to cover adequately the required area; also the turnover among patrolling staff from year to year results in inconsistencies in methodologies and estimates; and annual variations in weather, river turbidity, accessibility to spawning sites, and the shifting of spawning areas to new locations add to the difficulties of accurate enumeration.

In the past, a few of the Fraser River tributaries were examined intensively for spawner abundance using fence counts, Petersen disc mark - recapture, or systematic and thorough surveys. Such was the case, for example, for chinook from several lower Thompson River tributaries and from the Harrison and Pitt River systems (Append. 15); and for coho from several tributaries below Hope, including the Chilliwack River system (Append. 16). The gradual improvement over time in the quality of all escapement estimates in B.C. was largely due to improved road access, the use of aircraft, and the inclusion of previously unreported streams. It is suspected that these more extensive surveys are masking a declining trend in chinook and coho escapements which began to be observed in the 1960's. It is therefore impossible to distinguish whether some of the more recent (since late 1960's) higher returns (see below) signify a truly recovering population, or a declining one where new spawners are periodically discovered or for which

Table 19. Estimated chinook and coho catches by Indian food fishery, Fraser River, 1969-1980.[a]

Year	DISTRICT NO. 1				DISTRICT NO. 2				Total Fraser River
	Lillooet Sub-district	Combined Thompson River Sub-districts[b]	Combined Upper Fraser R. Sub-districts[c]	Total	Lower Fraser R. Sub-districts[d]	Mission-Harrison Sub-district	Chilliwack Sub-district	Total	
Chinook catch:									
1969	2,120	345	451	2,916	210	3,509	7,630	11,349	14,265
1970	2,060	1,830	1,312	5,202	260	5,825	7,171	13,256	18,458
1971	1,245	850	484	2,579	434	3,305	7,350	11,089	13,663
1972	1,990	140	484	2,614	305	4,375	8,714	13,394	16,008
1973	1,950	140	433	2,523	315	3,412	5,620	9,347	11,870
1974	1,685	300	538	2,523	353	4,750	10,343	15,446	17,969
1975	2,675	110	639	3,424	677	9,199	9,347	19,223	22,647
1976	1,700	69	701	2,470	787	4,650	10,519	15,956	18,426
1977	352[e]	178	662	1,192	1,162	5,910	13,547	20,619	21,811
1978	2,104[e]	350	806	3,260	961	5,506	10,335	16,802	20,062
1979	1,603	220	630	2,453	1,088	4,932	6,468	12,488	14,941
1980	2,000	50	280	2,330	2,378	4,889	5,626	12,893	15,223
Mean	1,790	382	618	2,791	744	5,022	8,556	14,322	17,112
Coho catch:									
1969	445	40	0	485	215	2,811	10,438	13,464	13,949
1970	770	200	0	970	1,380	4,820	11,430	17,630	18,600
1971	875	100	0	975	1,726	7,260	7,700	16,686	17,661
1972	940	60	0	1,000	1,812	5,240	12,720	19,772	20,772
1973	915	45	0	960	1,844	3,619	10,160	15,623	16,583
1974	1,000	25	0	1,025	7,515	9,010	11,555	28,080	29,105
1975	950	0	0	950	1,666	11,960	5,924	19,550	20,500
1976	345	12	0	357	2,820	13,005	11,265	27,090	27,447
1977	143[e]	0	0	143	2,044	8,288	5,801	16,133	16,276
1978	992[e]	0	0	992	4,154	6,434	11,261	21,849	22,841
1979	1,295	0	0	1,295	2,064	6,225	5,455	13,744	15,039
1980	1,000	30	0	1,030	4,449	9,990	14,958	29,397	30,427
Mean	806	43	0	849	2,641	7,389	9,890	19,918	20,767

[a] The data are arranged by DFO administrative sub-districts (see Append. 14 for a description of boundaries), and have been collected from Annual Narrative Reports from each sub-district (DFO, File No. 5871-BC 1-1 and 2).

[b] Includes Salmon Arm, Clearwater and Kamloops sub-districts.

[c] Includes Cariboo and Prince George sub-districts.

[d] Includes Coquitlam, Surrey and Steveston sub-districts.

[e] No data gathered for chinook and coho catches; estimated from the sockeye catch.

better (and higher) estimates are being made. It is probable that, although the B.C. catches of chinook and coho remained relatively high, the wild stocks of these species are in a general decline and the catch levels are being maintained by increased production of artificially propagated stocks as well as by the overharvesting of wild stocks.

CHINOOK ESCAPEMENTS

The annual (1951 - 1980) chinook escapement to the Fraser River has averaged 58,000 fish, ranging from a high of 124,000 in 1952 to a low of 27,000 in 1956 (Fig. 28, Table 20). After an apparent decline in chinook escapements in the 1960's, a gradual increase was observed since the late 1960's (Fig. 28). In the last 30 years, contributions to the total mean annual Fraser River chinook escapement by geographical region were largest from the lower Fraser River below Hope (31%) and the South Thompson River system (24%); smaller contributions were made by the lower Thompson River system (11%), the central Fraser River - Lillooet to Prince George (11%), all tributaries above Prince George (11%), and the North Thompson River system (8%); minor contributions to the historical escapements were made by the Nechako River system (3%) and the Fraser River - Hope to Lillooet (0.6%) (Table 20).

Escapements to individual watershed regions (10-year means, 1951 - 1980 data) show that the greatest apparent decline in chinook returns occurred in the lower Thompson River watershed (primarily the Nicola River, Append. 15f), from about 9,000 to 5,000 fish, while the greatest increase occurred in the central Fraser River watershed - Lillooet to Prince George (primarily the Chilko River, Append. 15c), from about 3,000 to 9,000 fish (Table 20). This latter increase is probably due to improved spawning count estimates rather than true increase in stock numbers. On the other hand, the decline in the Nicola River stocks is probably real and is assumed to be related to conflicts in allocating water resources between agricultural and fisheries needs (see below).

The lower Fraser River stocks (mostly Harrison River) showed considerable recovery since the early 1960's (from $\leq$10,000 to around 20,000 fish) (Table 20, Append. 15g). A concurrent decline and recovery pattern was observed in the historical white chinook catches (Table 11) and in the September/October catches by the terminal gillnet fishery (Table 10), where the majority of fish are believed to be of the lower Fraser River origin. Therefore, the above stocks probably underwent a real fall and rise in their escapement numbers.

The relatively stable escapements to the up-river areas above Prince George may be misleading because many rivers have been added to the spawning inventory, especially because road access has improved greatly in the last 30 years.

A detailed escapement record (1951 - 1980) for all known rivers and tributaries supporting chinook salmon in the Fraser River watershed is given in Appendices 15a - g.

COHO ESCAPEMENTS

Coho escapement estimates are probably the most unreliable of all the

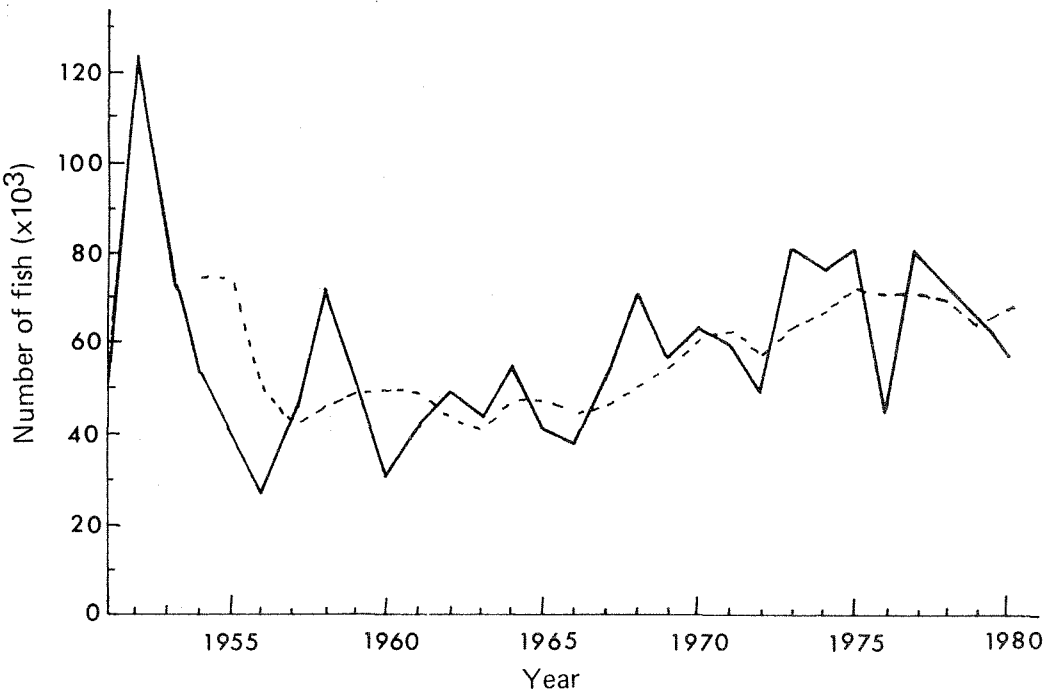


Fig. 28. Annual chinook spawning escapements in the Fraser River and four-year sliding averages (dotted line), 1951-1980.

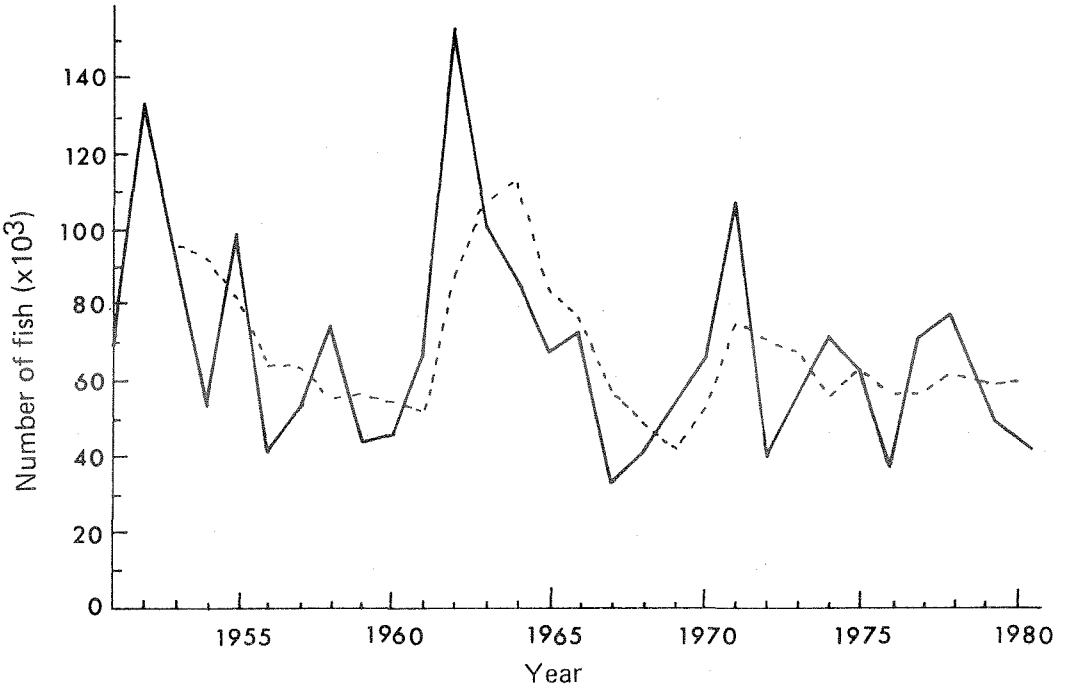


Fig. 29. Annual coho spawning escapements in the Fraser River and three-year sliding averages (dotted line), 1951-1980.

Table 20. Summary of chinook escapements to Fraser River by geographical region, 1951-1980.

YEAR	FRASER R., PRINCE GEORGE TO HEADWATERS	NECHAKO R. & TRIBS	FRASER R., LILLOOET TO PRINCE GEORGE	NORTH THOMPSON R. & TRIBS.	SOUTH THOMPSON R. & TRIBS.	LOWER THOMPSON R. & TRIBS.	FRASER R., HOPE TO LILLOOET	FRASER R., HOPE TO OUTLET	TOTAL ESCAPE-MENT
1951	7500	3925	2680	3425	7325	9825	325	5050	40055
1952	7500	4250	1845	1625	17400	10925	350	79925	123820
1953	9750	2525	1875	10050	24250	10970	125	19075	78620
1954	8950	2000	2225	6175	5650	10550	50	18275	53875
1955	6350	825	2100	3125	7200	10700	450	10450	41200
1956	5725	650	1700	2300	8250	825	225	6875	26550
1957	7000	575	1875	7000	12275	5525	150	9325	43725
1958	8650	2650	3600	6000	16850	12050	229	21625	71654
1959	2300	760	5900	3850	6475	12175	75	20400	51935
1960	1050	340	2500	2954[a]	11150	5975	400	5425	29794
1961	10200[a]	1452[a]	2000	7897[a]	11525	1550	275	6725	41624
1962	8400[a]	1025	4350	7500[a]	14325	6050	275	7100	49025
1963	4400	1290	3200	2925	9575	6000	275	15759	43424
1964	5975	1500	12475	4125	13425	8425	300	8750	54975
1965	2775	685	6905	6150	8125	5475	900	10100	41115
1966	3465	795	6000	3850	10775	1395	15	11544	37839
1967	3825	1262	6517	3800	22975	4250	125	8700	51454
1968	3675	856	7175	2125	15725	5910	120	35400[b]	70986
1969	3925	1025	9375	4050	21325	6865	225	9500	56290
1970	7650	1790	12150	4075	18525	7545	350	11000	63085
1971	5575	1367	7650	3796	12625	5395	350	22975	59733
1972	5850	779	4750	3600	12350	4020	135	16850	48334
1973	5460	1437	10400	3810	16800	6650	350	36550	81457
1974	6260	1950	5425	3340	17725	5025	300	36350	76375
1975	4733	2500	14600	2610	27325	11200	975	16225	80168
1976	6157	1655	10000	5250	5300	6430	500	9050	44342
1977	7530	2840	11500	6250	20496	3600	865	27075	80156
1978	10015	4200	12500	6965	17320	4260	1120	16325	72705
1979	9695	3025	8000	3610	18860	2700	370	16425	62685
1980	11671	4625	9200	4302	8910	6235	450	10995	56388
1951-60	6478	1850	2630	4650	11683	8952	238	19643	56123
1961-70	5429	1168	7015	4650	14630	5347	286	12458	50982
1971-80	7295	2438	9403	4353	15771	5552	542	20882	66234
1951-80	6400	1819	6349	4551	14028	6617	355	17661	57780
% OF TOTAL	11	3	11	8	24	11	1	31	100

[a] Fraser River Board estimates for escapements are used instread of Fishery Officers' estimates.

[b] Petersen tag estimate of 34,000 for total Harrison River population is used instead of Fishery Officers' estimate of 7,500.

estimates for the five species of Pacific salmon. This is because this species returns to the spawning grounds over a long period of time (for one to four months) during the most inhospitable time of year, and is therefore rarely present in the river in large numbers during any one survey. Given the infrequent nature of winter coho enumerations, coho returns are often seriously underestimated. Another source of error stems from a requirement in the past by the Department of Fisheries and Oceans that all escapement estimates be filed by December 31 of the year in question. However, many coho in the lower Fraser River do not appear on the spawning grounds until after that date. Coho may also be overestimated because of their tendency to school in deep pools in the manistem of rivers. This is probably why large spawning populations of this species are often recorded in river mainstems where they actually rarely spawn (for example, the Vedder-Chilliwack River).

The annual (1951 - 1980) coho escapement to the Fraser River has averaged 69,000 fish, ranging from a high of 153,000 in 1962 to a low of 33,000 in 1967 (Fig. 29, Table 21). A large escapement peak, observed in the early 1960's, may be more an artifact from grossly overestimating the escapements to the Chilliwack River system, than true fish abundance (Append. 16h). This is supported by the fact that terminal gillnet catches during that period were not particularly high (Table 15), and escapements in subsequent years did not reflect these strong brood years (Appen. 16h). Contributions by geographical region to the total mean annual Fraser River escapement since 1951 were largest from the Chilliwack River watershed (27% of total), the North, South and lower Thompson River systems (26%), and the Harrison River basin (13%) (Table 21).

Escapements to individual watershed regions (10-years means, 1951 - 1980 data) show a strong decline in the Thompson River stocks, from approximately 22,000 to 14,000 fish (Table 21). The actual decline is probably greater, but may be masked by increased effort in spawning surveys. This decline may have been caused largely by the heavy exploitation of the Thompson River stocks in the September gillnet fishery (Fig. 22). Stock declines from exploitation are also suspected for the Lillooet system and for the lesser stocks below Lillooet to Hope (Table 21), but again the declines may have been countered by intensified surveying.

The lower river stocks below Hope (with the possible exception of the Chilliwack River) seem to be relatively stable or even increasing (Table 21). The apparent stability of these stocks may be attributed to more accurate enumeration which may be masking a declining trend, and to a lower terminal exploitation rate since the 1960's when late-season fishery closures were imposed. This was done in order to protect the Fraser River chum (Palmer 1972) which have a similar timing through the fishery to the lower river coho stocks (Fig. 6). Most of the latter stocks (except the Chilliwack River) showed depressed numbers in the late 1950's and in 1960's, which may be partly due to delayed effects of heavy exploitation on the Fraser River chum during the 1950's (Palmer 1972). The subsequent apparent recovery of these coho occurred despite a probable considerable degradation of spawning and rearing habitats in the lower Fraser River (see below).

The Chilliwack River system does not show the above decline-recovery pattern from 1950's to 1970's probably because of poor escapement estimates which may be concealing the actual pattern (Append. 16h). Considerable research conducted on the Chilliwack River coho stocks since 1975, suggests that these populations were seriously overestimated in the past.

Table 21. Summary of coho escapements to Fraser River by geographical region, 1951-1980.

YEAR	SOUTH THOMPSON R. & TRIBS.	NORTH THOMPSON R. & TRIBS.	LOWER THOMPSON R. & TRIBS.	FRASER R., HOPE TO LILLOOET	UPPER LILLOOET R. & TRIBS.	HARRISON R. & TRIBS.	FRASER R., HOPE TO MISSION, N. SIDE	FRASER R., MISSION TO MOUTH, N. SIDE	CHILLI-WACK R. & TRIBS.	FRASER R., HOPE TO MOUTH, S. SIDE	TOTAL ESCAPE-MENT
1951	3400	2100	5075	800	15925	4750	1975	6900	17250	2175	60350
1952	14900	7175	6525	1200	35100	15275	3250	17300	19125	9325	129175
1953	11000	13200	3900	500	5875	19550	5700	10625	17025	8150	95525
1954	5000	7100	3750	300	2000	9825	6925	6075	10100	2600	53675
1955	23750	17975	18000	3925	2275	5150	2675	6825	17046	1900	99521
1956	8200	2650	400	450	3875	3675	2275	1925	15850	1100	40400
1957	7750	3250	1725	1727	2075	9125	4300	4550	16500	1525	52527
1958	15825	1850	2450	400	2650	5725	1900	5400	36250	1725	74175
1959	8100	2550	400	225	2650	7050	3050	1125	16600	2175	43925
1960	10925	5653	2325	302	4400	8350	1575	1700	8975	1725	45930
1961	14325	12425	1375	650	4025	10350	2225	4100	16350	1550	67375
1962	9725	10850	900	15775[a]	4525	17500	4725	9875	77500[a]	1500	152875
1963	6525	2775	1250	300	5325	4575	1925	1675	76250[a]	1350	101950
1964	10300	6450	125	846	5075	10050	5400	10200	36250	1700	86396
1965	11400	13650	5850	3125	5325	9726	2735	3300	10500	1500	67111
1966	4500	5175	7875	1750	5375	18030	4856	5675	17900	1950	73086
1967	1700	2450	450	580	4700	9050	3775	3150	5939	1111	32905
1968	6050	5325	2370	1021	4875	6400	3200	2325	8065	1407	41038
1969	6775	6950	7845	2200	5240	6900	3775	2300	10069	1215	53269
1970	5100	8650	3575	3725	8325	11600	2550	6850	10950	4825	66150
1971	4938	9198	2320	2575	11700	15925	5200	40550	9000	7150	108556
1972	6904	6087	1040	1790	5625	4000	950	4250	5080	3895	39621
1973	4774	7445	2010	2300	3450	7550	2225	8250	14500	4350	56854
1974	7155	12084	2310	1800	10175	7450	3100	7200	12820	8080	72174
1975	4090	5724	885	2525	10050	11700	3925	6175	9455	7120	61649
1976	2802	3130	1155	1225	4100	3550	2325	5275	8052[b]	6325	37939
1977	6385	9322	950	2495	6800	9000	3900[b]	11555[b]	14784[b]	6550[b]	71741
1978	5895	7762	2350	4030	8300	5825	2800[b]	20311[b]	11401[b]	9075[b]	77749
1979	7538	5149	355	1800	6150	6850	2625	6907	13948[b]	5124	56446
1980	4951	2554	75	2236	9550	5255	3730	5364	5095	3088	41898
1951-60	10885	6350	4455	983	7683	8848	3363	6243	17472	3240	69520
1961-70	7640	7470	3162	2997	5279	10418	3517	4945	26977	1811	74216
1971-80	5543	6846	1345	2278	7590	7711	3078	11584	10414	6076	62463
1951-80	8023	6889	2987	2086	6851	8992	3319	7590	18288	3709	68733
% OF TOTAL	12	10	4	3	10	13	5	11	27	5	100

[a] Probably a serious overestimate.

[b] Extensive modifications of Fishery Officers' estimates made after intensive reconnaissance work by Field Services Branch, DFO.

A detailed escapement record (1951 - 1980) for most of the known rivers and tributaries supporting coho salmon in the Fraser River watershed is given in Appenices 16a - j.

TOTAL RETURN TO THE FRASER RIVER

CHINOOK

Total return of chinook to the mouth of the Fraser River (escapement plus terminal catch) shows a strong decline since the early 1970's (Fig. 30, Table 22). Prior to those years, the decline appeared to be more gradual. This decline in the return of chinook can be attributed primarily to outside fisheries, particularly sport and troll fisheries which are taking a progressively larger share of the available production (Fig. 31) and leaving less for terminal fishermen and for escapement. The annual chinook spawning escapement in the Fraser River during 1951 to 1980 shows a slight rise since the late 1960's (Fig. 28) and may be due in part to increased enumeration efforts as suggested earlier, and to successful attempts at conserving chinook in the terminal area through net regulations. Meanwhile, however, the catch has been reallocated away from the terminal user and towards the interceptor: the troll, sport and seine net fisherman.

Certain chinook fisheries can be singled out as having increased significantly their catch during 1951 to 1980, and none show a decline during that period. Some fisheries, such as the west coast of Vancouver Island and the west coast of Washington troll fisheries (the latter has been greatly reduced in recent years), have increased their catch greatly but, being directed primarily at Columbia River stocks, probably have less impace on Fraser River stocks (DFO, unpublished data). Other fisheries, such as the Georgia Strait troll, northern troll (Fig. 31), and the Georgia Strait sport fisheries (DFO, unpublished data) have also increased their catch and are likely impacting heavily on the Fraser River stocks. Likewise, the Puget Sount net fishery, which has increased its catch significantly since the early 1970's (Fig. 31), harvests primarily returning spawners and could have a considerable impact on Fraser River stocks, especially at Point Roberts where American seiners operate close to the mouth of the Fraser River.

Only terminal exploitation rates are available for chinook since the actual offshore catch of Fraser River stocks is largely unknown. Terminal exploitation rates have dropped from over 75% in the 1950's to around 50% in the late 1970's (Table 22). However, the rates estimated for the 1950's and 1960's may be too high because, in that case, the overall exploitation would be in excess of 90% with the stocks showing no real decline.

Since the outside fisheries continued to increase their catch in the last 30 years and the stocks showed no strong decline in returns to the river until the early 1970's (Fig. 30), it is concluded that over-harvesting did not become serious until that time. The calculated terminal exploitation rates until the early 1970's were very high (>70%) and closer to the range expected for overall exploitation (Table 22), making outside exploitation unaccounted for. These early exaggerated terminal exploitation rates may be due to underestimation of the Fraser River chinook escapements for that period. In order to bring the terminal exploitation rates into a lower range of 50% to 60%, chinook escapement estimates for the 1950's and 1960's would have to be increased on the order of one and a half to two times. If this is done, the

Fig. 30. Annual total return of chinook to the Fraser River and four-year sliding averages (dotted line), 1951-1980.

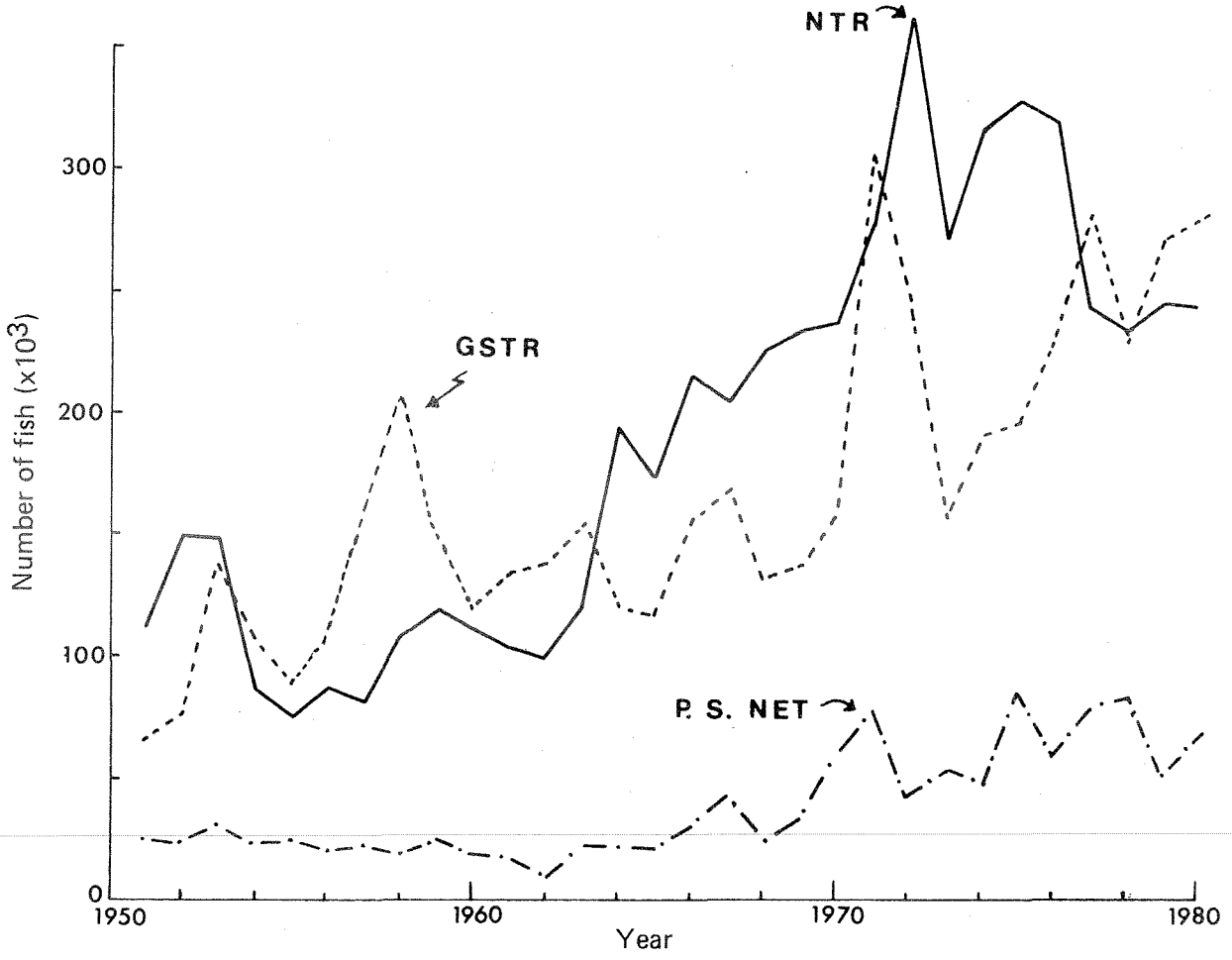


Fig. 31. Chinook catch by mixed-stock fisheries (GSTR-Georgia Strait troll; NTR-northern troll; P.S.Net-Puget Sound gillnet and seine fisheries), 1951-1980.

Table 22. Total return of chinook to the Fraser River and terminal exploitation rate, 1951-1980.

YEAR	AREA 29 COMMERCIAL CATCH	RIVER INDIAN CATCH [a]	RIVER SPORT CATCH [a]	TOTAL TERMINAL CATCH	ESCAPE-MENT	TOTAL CHINOOK RETURN	TERMINAL EXPLOIT. RATE (%)
1951	147197	17000	13000	177197	40055	217252	82
1952	131800	17000	13000	161800	123820	285620	57
1953	176142	17000	13000	206142	78620	284762	72
1954	179082	17000	13000	209082	53875	262957	80
1955	139087	17000	13000	169087	41200	210287	80
1956	123137	17000	13000	153137	26550	179687	85
1957	123633	17000	13000	153633	43725	197358	78
1958	167288	17000	13000	197288	71654	268942	73
1959	165736	17000	13000	195736	51935	247671	79
1960	119510	17000	13000	149510	29794	179304	83
1961	89042	17000	13000	119042	41624	160666	74
1962	108617	17000	13000	138617	49025	187642	74
1963	112292	17000	13000	142292	43424	185716	77
1964	161195	17000	13000	191195	54975	246170	78
1965	90870	17000	13000	120870	41115	161985	75
1966	95750	17000	13000	125750	37839	163589	77
1967	115383	17000	13000	145383	51454	196837	74
1968	103024	17000	13000	133024	70986	204010	65
1969	86189	14265	12800	113254	56290	169544	67
1970	124753	18458	23080	166291	63085	229376	72
1971	132201	13668	19128	164997	59733	224730	73
1972	121146	16008	19702	156856	48334	205190	76
1973	94518	11870	11606	117994	81457	199451	59
1974	67778	17969	7676	93423	76375	169798	55
1975	73833	22647	12228	108708	80168	188876	58
1976	79869	18426	11737	110032	44342	154374	71
1977	90893	21811	9012	121716	80156	201872	60
1978	54062	20062	9053	83177	72705	155882	53
1979	51511	15778	9934	77223	62685	139908	55
1980	39014	15000	6700	60714	56084	116798	52
1951-55	154662	17000	13000	184662	67514	252176	74
1956-60	139861	17000	13000	169861	44732	214592	80
1961-65	112403	17000	13000	142403	46033	188436	75
1966-70	105020	16362 [b]	17940 [b]	136740	55931	192671	71
1971-75	97895	16432	14068	128396	69213	197609	64
1976-80	63070	18215	9287	90572	63194	153767	58
1951-80	112152	17164 [c]	12721 [c]	142106	57769	199875	71

[a] No data available from 1951 to 1968; observed number is the annual mean for the period 1969 to 1980.
[b] Mean of 1969 and 1970.
[c] Mean of 1969 to 1980.

total return of chinook to the Fraser River (Fig. 30) would show a steady decline in the last 30 years. Meanwhile, the total production has remained unchanged or even increased over that same period, as indicated by the strong chinook catches throughout the coast up to about 1975 (Fig. 31). The fact that the catch of most chinook fisheries is beginning to show a decline (for example, west coast Vancouver Island troll and northern troll) indicates that increases in hatchery production have not kept up with increases in the overall exploitation rate, and that perhaps, at present, the natural escapement is being harvested, causing the overall decline in total production.

COHO

Total return of coho to the mouth of the Fraser River (escapement plus terminal catch) shows little discernible pattern, although there is some evidence for a gradual overall decline (Fig. 32, Table 23). This is in contrast to the chinook returns which show a consistent decreasing trend, especially since the early 1970's, because of increasing outside catch (Figs. 30 & 31). Part of the reason for the apparently erratic behaviour of Fraser River coho returns is that, unlike chinook, there is no consistent directed fishery for coho in the terminal area. Instead, the coho are taken incidentally in the late sockeye and pink fisheries and in chum fisheries. If the concurrently migrating stocks of these other species are weak, the fishery is restricted and the coho catch is small. For example, chum fishing in the Fraser River has been reduced considerably in the 1970's because of weak returns and changing fishing patterns, thereby allowing more coho to enter the spawning grounds. However, because the enumeration of coho is sporadic, increases in escapement abundance are not always fully reflected in the spawning counts. Therefore, full reliability cannot be placed on the total return estimates for coho or on their terminal exploitation rates because they may not accurately reflect changes in coho abundance.

Likewise, it is difficult to point to the mixed-stock fisheries as the source of possible coho decline. Some fisheries, such as the Georgia Strait troll, actually reported reduced catches during 1951 to 1980 (Fig. 33), although some increase has occurred since 1975, probably due to increased hatchery production of coho. Other fisheries, such as the west coast of Vancouver Island troll fishery, have shown increased catches (Fig. 33). Both of these fisheries probably impact heavily on Fraser River coho stocks (see section on "Coho exploitation outside Area 29"). The Georgia Strait sport fishery, which undoubtedly increased its catch greatly, especially in the last decade, is another important exploiter of Fraser River coho stocks.

Terminal exploitation rates on coho during 1951 to 1980 were generally lower than those on chinook (range of 48% to 65% for coho [five-year means], compared to 58% to 80% for chinook [five-year means]; Tables 22 and 23).

At present, it is difficult to say with certainty that the Fraser River coho stocks are being overharvested. Evidence from escapement counts on the spawning grounds indicates that stocks above Hope are declining, while lower river stocks are near the 1950's escapement levels (see section on "Coho escapements"). However, if there is a strong enumeration bias for coho, as there appears to be for chinook (early escapement counts were underestimated relative to present escapement counts), all Fraser River coho stocks could be declining. If the up-river coho stocks enter the river earlier than the stocks below Hope, the above observation that the up-river stocks are in a

Fig. 32. Annual total return of coho to the Fraser River and three-year sliding averages (dotted line), 1951-1980.

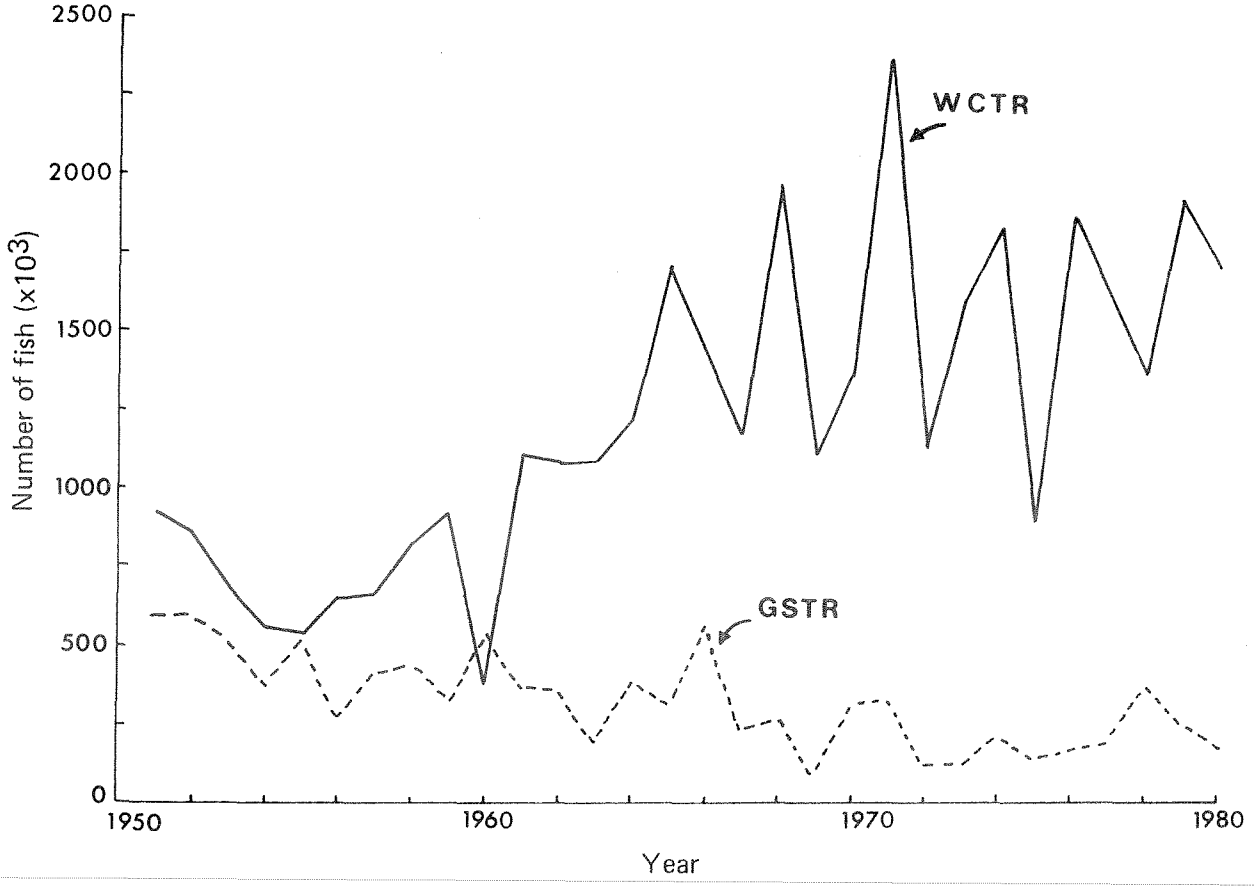


Fig. 33. Coho catch by mixed-stock fisheries (GSTR-Georgia Strait troll; WCTR-west coast of Vancouver Island troll), 1951-1980.

Table 23. Total return of coho to the Fraser River and terminal exploitation rate, 1951-1980.

YEAR	AREA 29 COMMERCIAL CATCH	RIVER INDIAN CATCH[a]	RIVER SPORT CATCH[a]	TOTAL TERMINAL CATCH	ESCAPE-MENT	TOTAL COHO RETURN	TERMINAL EXPLOIT. RATE (%)
1951	123874	21000	6000	150874	60350	211224	71
1952	79846	21000	6000	106846	132675	239521	45
1953	73038	21000	6000	100038	95525	195563	51
1954	132063	21000	6000	159063	53675	212738	75
1955	73284	21000	6000	100284	99521	199805	50
1956	124669	21000	6000	151669	40400	192069	79
1957	48572	21000	6000	75572	52527	128099	59
1958	76290	21000	6000	103290	74175	177465	58
1959	58749	21000	6000	85749	43925	129674	66
1960	56342	21000	6000	83342	45930	129272	64
1961	32046	21000	6000	59046	67375	126421	47
1962	67993	21000	6000	94993	152875	247868	38
1963	35932	21000	6000	62932	101950	164882	38
1964	132712	21000	6000	159712	86396	246108	65
1965	42031	21000	6000	69031	67111	136142	51
1966	37094	21000	6000	64094	73086	137180	47
1967	33466	21000	6000	60466	32905	93371	65
1968	81973	21000	6000	108973	41038	150011	73
1969	22870	13949	4875	41694	53269	94963	44
1970	99085	18600	14075	131760	66150	197910	67
1971	69527	17661	8067	95255	108556	203811	47
1972	80923	20772	3191	104886	39621	144507	73
1973	53550	16583	2737	72870	56854	129724	56
1974	26176	29105	3893	59174	71874	131048	45
1975	43242	20500	3261	67003	61649	128652	52
1976	14145	27447	11781	53373	37939	91312	58
1977	42230	16276	11149	69655	71741	141396	49
1978	51021	22841	4665	78527	77699	156226	50
1979	7710	20000	3000	30710	56446	87156	35
1980	32560	29397	2000	63957	41898	105855	60
1951-55	96421	21000	6000	123421	88349	211770	58
1955-60	72924	21000	6000	99924	51391	151316	65
1961-65	62143	21000	6000	89143	95141	184284	48
1966-70	54898	16275[b]	9475[b]	81397	53290	134687	59
1971-75	54684	20924	4230	79838	67711	147548	55
1976-80	29533	23192	6519	59244	57145	116389	51
1951-80	61767	21094[c]	6058[c]	88828	68838	157666	56

[a] No data available from 1951 to 1968; observed number is the annual mean for the period 1969 to 1980.
[b] Mean of 1969 and 1970.
[c] Mean of 1969 to 1980.

greater decline than the lower river stocks is probably valid. The early migrating stocks are exploited by a September sockeye fishery, which commonly occurs each year, and by directed outside net fisheries, particularly in Puget Sound; the later migrating coho are mostly unaffected by the terminal net fisheries (with the exception of the Point Roberts chum seine fishery) and appear to be doing relatively better. In general, the Fraser River coho are probably not as seriously overharvested as the chinook stocks, but the evidence is ambiguous and future study may reveal serious problems with this resource.

CONFLICTING DEMANDS ON THE WATER RESOURCES OF THE FRASER RIVER

The apparent decline, especially of specific stocks of chinook and coho salmon returning to the Fraser River, is thought to have occurred because of two major causes. The first, although difficult to prove conclusively with the available data (see above), is the overexploitation of stocks beyond their capacity to recover in the next generation. The second major cause of stock decline is the heavy demand by various users on a limited water resource; chinook and coho salmon with their extended freshwater rearing phase, are particularly susceptible to any damage to their freshwater habitat. The continued ability of the Fraser River to support salmonid populations is due largely to its still relatively good (although declining) condition of fish habitat compared to other major river systems (Dorcey et al. 1976). However, since the erosion of the Fraser River fish habitat is a slow and steady process, it is difficult to find examples where dramatic declines in fish stocks have occurred due to habitat conflicts.

In this review, major habitat conflicts between man and fishery resource in the Fraser River watershed are categorized and highlighted to show the main problem issues.

Society's demands on the Fraser River water resource which greatly affect salmonids, can be categorized into three major groups: 1) hydroelectric and dam construction development leading to the loss of migration routes and of rearing and spawning area; 2) the use of the river for the disposal of wastes, either industrial or domestic; and 3) the development of land in the watershed. Although the latter does not alter the water resource directly, it has important secondary effects such as changes in run-off patterns, irrigation demands, or the input of undesirable materials which otherwise would have remained on land. Each of the above categories will be discussed briefly in the following sections with particular reference to problems currently being encountered in the Fraser River watershed.

Hydroelectric development

Presently, there are two major and several smaller hydroelectric developments in the Fraser River watershed. The major ones are the Kemano I development (begun in 1950) on the Nechako River, which resulted in serious disruption of chinook spawning populations downstream of the impoundment, and the Bridge River project which blocked off substantial populations of chinook and coho in 1954 (Fig. 1). A small dam on the Middle Shuswap River (built in the late 1920's) also resulted in losses of chinook and coho stocks. Other lesser developments which affected anadromous fish stocks are located on the Stave River, the Alouette River, and the Wahleach (Jones) Creek, all in the lower Fraser Valley (Fig. 1). The above developments at present have water

discharge regimes which do not always suit the requirements of anadromous fish downstream of the impoundment.

The long history of proposals for hydro development in the Fraser River watershed is centered around the need for flood control and the desire for cheap hydroelectric power. The first report issued by the Fraser River Board (1958) identified 59 dam sites and made recommendations which initiated the first biological work on the up-river Fraser chinook (Chatwin et al. 1961, 1962, 1963). The second report (Fraser River Board, 1963) rejected the building of most of the proposed dams, and instead recommended a series of dams on four major tributaries and on the mainstem above Prince George, which would have a generally minor effect on anadromous stocks. This proposal, termed "System E", was designed primarily to reduce the probability of a repeat of the 1948 flood and was to be financed through the sale of electricity. Considerable study was generated on the biological and economic aspects of these developments (for example, Paish and Associates 1973; Pearse Bowden Consultants 1973; Environment Canada 1974). However, subsequent cost-benefit analyses rejected all of the proposed sites except for the McGregor River project. In 1978, British Columbia Hydro Corporation dropped their development plans for the McGregor River probably due to enormous opposition and a consultant's report identifying parasite transfer problems into Arctic river drainages. A specific Fraser River site, located just above Lillooet, is periodically reviewed as a possible storage dam site (Moran Dam) because of its potential as a very inexpensive power source. However, it is unlikely that Moran Dam will be built due to substantial economic and biological obstacles (Geen 1975).

Waste discharge

The total daily discharge of waste material to the Fraser River in 1970 was estimated at 1,340,000 m^3 per day (Hedlin Menzies and Associates 1971). This is the sum of all the discharges into the Fraser River released from municipalities, forest industry operations, mining waste treatment operations, and food processing plants. The total waste discharge represents about 0.5% of the average daily discharge at Hope or about 2% of the average March discharge.

In a careful study of the conditions of the Fraser River below Hope, the Westwater Research Centre of the University of British Columbia stated that, with some qualifications, the Fraser River waters below Hope are relatively healthy (Dorcey et al. 1976). The study observed that oxygen levels were high throughout the lower river, with possible exceptions in some parts of the North Arm, but that unacceptable levels of trace metals and coliforms were present below New Westminster. The report also cautioned that additional waste discharges could make the lower river extremely inhospitable for fish and other aquatic organisms in the near future. The general impression received from the above studies was that of a river in a remarkably good shape, considering the uses it is being subjected to, and of a river on the brink of a potential disaster if some abuses were not controlled.

Local waste discharge problems are particularly evident near Prince George and Kamloops, the two largest communities in the Fraser River watershed outside the lower Fraser Valley (Fig. 1). The Prince George area with its three pulp mills and a local population in excess of 60,000, is developing potentially serious salmonid migration problems during the low flows in mid-summer. Eutrophication of the Thompson River below Kamloops Lake in the form

of algal blooms, was attributed to the release of excessive nutrients from the city of Kamloops sewage lagoons and the Weyerhauser pulp mill (Thompson River Task Force 1976). The pulp mill was also identified as the source of chemical effluent imparting colour to the river and an off-taste to rearing fish. In 1980, the city of Kamloops applied to the province for a permit to increase its allowed discharge of sewage.

Land development

Land development includes forest harvesting, agriculture, housing development, mining, and industrial use, as well as the filling in of marsh or estuarial land for development purposes, and the dyking and channelization of river courses to protect present or future land developments. This subject is extremely complex and cannot be covered adequately in this section. Briefly, this form of development is ubiquitous throughout the Fraser River watershed and has the potential to do great harm to salmonid rearing and spawning habitats.

Forest harvesting occurs throughout the Fraser River watershed, but it affects anadromous stocks particularly in the North Thompson, upper Fraser, Quesnel, and West Road River watersheds (Fig. 1). The removal of forest cover alters run-off patterns within the watershed where forest cover normally holds back some of the precipitation or snow-melt. Sediment loads are increased in the water course and, when trees are cut right to the bank, habitat cover for rearing is eliminated. The deleterious effects of forest harvesting on rearing coho are well documented by Narver (1972), Chapman (1965), and others.

Agricultural conflicts with chinook and coho requirements are particularly serious in the central interior plateau of the watershed where, in areas of limited rainfall, farmers use large quantities of water for irrigation. This water extraction results in reduced spawning and rearing habitats during low flow periods.

In the Nicola River, a flood irrigation system is practiced which requires the field to be flooded by a series of ditches originating in the river. When the irrigation is completed, the ditches are closed off, leaving many salmonid juveniles stranded. The Nicola River is one of the few rivers in the Fraser River watershed where the decline in salmonid stocks is probably closely related to water use conflicts. Other rivers where similar problems exist are Deadman River, Salmon River (Shuswap Lake), and Bessette Creek (Fig. 1).

Land development for housing and industrial uses occurs throughout the watershed, but is especially prevalent in the lower Fraser Valley. Large tracts of agricultural land also exist there, but the water-use conflict situation is less serious. The agricultural, municipal, and industrial land is protected by an extensive system of dykes. There is also a gradual filling in of estuarial foreshore for housing and industrial uses. It is estimated that only about 60% of the original Fraser River salt marsh and tidal marsh habitat is left in its pristine state but, if all natural estuarine habitat is considered, only 21% is left intact; the remainder was filled in or water access to it was blocked off by dyking (Forrester et al. 1975).

Presently mining has relatively minor effects on the fisheries resource in the Fraser River. Place mining for gold in the Quesnel River in the 19th century nearly destroyed that river. Today, this practice is under control,

although recent increases in gold values have caused a renewed interest in placer mining. Extensive low-grade copper deposits are found in the hills between Kamloops and Merritt and several mines are presently operating there, but their effects on the anadromous resource are negligible. However, the Afton copper mine, 15 km west of Kamloops, is incorporating a smelter which will discharge 1.8 kg of mercury, 1.1 kg of lead, zinc, and cadmium, and 1.0 kg of arsenic per day in its smoke emissions (B.C. Research 1976). It is not know how rapidly, if at all, these contaminants will find their way into the water system. However, since the size of the copper deposit is limited, the life of the Afton smelter is expected to be only 14 years (B.C. Research 1976).

SUMMARY

1. The largest river in British Columbia, the Fraser River, supports seven species of anadromous salmonids, among them chinook and coho salmon stocks. Approximately 1,350 km of the river mainstem, up to Rearguard Falls, are accessible to salmon.

CHINOOK

2. Fraser River chinook appear to have three major juvenile life-history patterns. In the first life-history pattern, the "immediate" migrants, or recently emerged fry, move rapidly seaward, presumably utilizing all available lower river rearing areas including the estuary; this life-history strategy is thought to be most prevalent among the Harrison River fall, white chinook stocks. In the second life-history pattern, "ocean-type" migrants rear in freshwater for 60 to 150 days, then migrate to sea as smolts in their first summer; the majority of red chinook are believed to follow this strategy. In the third life-history pattern, "stream-type" migrants rear a full year in freshwater before migrating to sea as smolts during their second spring; a smaller, but significant proportion of red chinook and some white chinook follow this pattern.

3. There is strong evidence that all three life-history strategies, and especially the "immediate" migrants, utilize the estuary as an intermediate rearing area before migrating to sea. After entering the ocean, Fraser River chinook probably migrate in a northwesterly direction, staying near the continental shelf and its fich feeding grounds. There is some evidence that the red chinook stocks do not linger in Georgia Strait, but travel north to rear in the southeastern Alaskan waters. Fall, white chinook stocks, on the other hand, tend to remain in Georgia Strait or may rear off the west coast of Vancouver Island.

4. Returning chinook enter the Fraser River from March to October. Two distinct groups based on flesh colour are observed: red chinook and white chinook. Red chinook enter the river during late spring and summer and generally migrate to up-river tributaries; white chinook start to appear in the terminal fishery in mid-summer and dominate that fishery in the fall (September and October). White chinook are believed to spawn mostly in the Harrison River, a lower river tributary.

5. Chinook spawn throughout most of the Fraser River watershed, from mid-August to early November. Peak spawning for red chinook occurs in

September and early October; it occurs in late October or early November for white Harrison River chinook. Over 95% of both the red and white Fraser River chinook return to spawn in their third, fourth or fifth year,with the four-year-olds usually being the dominant age group (>50%). Fecundity ranges from 3,000 to 6,500 eggs per female, depending on race.

6. Fraser River chinook are highly vulnerable to offshore troll fisheries, including those off Alaska and northern B.C., in Georgia Strait, and less so off the west coast of Vancouver Island. In addition, they are vulnerable to interception net fisheries in Johnstone and Juan de Fuca Straits and to the sport fishery in Georgia Strait. A significant terminal gillnet fishery, as well as sport and native food fisheries also occur in the river.

7. Gillnet catches (by number and weight) of chinook in the Fraser River declined by 60% since 1951. Early season catches (before June 30) declined the most (by 70%), while middle season catches (July and August) declined the least (by 51%) and mostly in the last decade. Late season catches (September and October) declined by 60%, but their contribution to the annual catch has recently recovered (from 20% in 1960's to present 37%). Most of the mean annual (1951 - 1980) gillnet catch was made during July, August and September (70% of total). Seasonally, mean (1951 - 1980) catch per delivery varied from 2.4 to 3.8 fish. Mean (1951 - 1980) landed weight of chinook varied from a low of 6.1 kg before May, to a high of 9.1 kg in October.

   Red chinook dominate the gillnet catch until the end of August; white chinook dominate the catch from early September to end of the season. The mean annual (1951 - 1980) gillnet landings of red chinook were nearly twice those of white chinook (60,000 red vs. 37,000 white). Mean landed weight of red chinook (7 kg - 8 kg) was lower than the mean weight of white chinook (9 kg - 10 kg.).

8. The chinook troll fishery off the mouth of Fraser River (Area 29) is relatively insignificant, harvesting immature feeding fish (3 kg mean dressed weight) of mixed stock origin. However, outside troll fisheries, especially in northern waters, are among the major harvesters of Fraser River chinook.

9. The chinook sport fishery within Fraser River harvests annually around 13,000 fish or about 7% of the mean annual (1969 - 1980) chinook return to the river. The Georgia Strait sport fishery may harvest over 100,000 Fraser River chinook annually and is considered to be a major source of exploitation of the Fraser River chinook.

10. The Indian food fishery harvests annually approximately 17,000 to 20,000 Fraser River chinook, or abut 11% of the mean annual (1969 - 1980) chinook return to the river.

11. Spawning escapements to the Fraser River averaged 58,000 chinook during 1951 to 1980. Historical escapement trends show a decline into the early 1960's, followed by a gradual increase to the present time. Improved survey techniques and accumulated knowledge of stocks have led to more accurate determinations of spawning populations, and may have caused the masking of any overall stock declines. The Harrison River escapements probably underwent a real decline in the 1960's and a recovery in

the 1970's; this pattern of decline and recovery was also observed in the historical late season catches and in the white chinook catches. The Lower Thompson River stocks show a long-term decline, reflecting water resource conflicts in this arid region.

12. Total return of chinook to the mouth of the Fraser River (escapement plus terminal catch) shows a strong decline since the early 1970's. This decline is attributed to increasing ocean sport and troll fisheries, including the Georgia Strait sport and troll fisheries and the northern (north of Vancouver Island) troll fishery, all of which reallocate catch away from the terminal area. There is some evidence to indicate that escapements may have been underestimated in the 1950's and 1960's, based on the high terminal exploitation rates calculated for that period.

COHO

13. Fraser River coho rear for at least one full year in fresh water before migrating to sea as smolts during the spring freshet. Some juveniles residing in cold, unproductive streams, may remain there for another year (about 5% of the population, based on adult returns). After their downstream migration, coho smolts use the outer estuary for further rearing. Strong evidence suggests that coho populations are more limited by the availability of freshwater rearing habitat than of spawning area.

14. Fraser River coho rear primarily in Georgia Strait, in and around the mouth of Juan de Fuca Strait, and off the west and northwest coast of Vancouver Island. Migrations further north or south are possible, but not common. Residency inside or outside of Vancouver Island may vary from year-to-year for each stock, and numbers of coho remaining resident in Georgia Strait may change drastically from year-to-year.

15. Returning coho become abundant at the Fraser River mouth in early September. The up-river stocks above Hope probably dominate the September run; the more numerous lower river stocks probably enter the river from late September to mid-November, depending on the specific stock.

16. Coho spawn mainly below and including the Thompson River system. Stocks above Hope generally spawn in late October and during November. Stocks below Hope generally spawn in December, with some stocks extending their spawning into January and February. Over 90% of returning coho are three-year-olds, with some 8% returning as two-and four-year-olds. Mean fecundity is estimated at 2,600 eggs.

17. Fraser River coho are harvested mainly by troll fisheries in Georgia Strait and off the west coast of Vancouver Island, by the Georgia Strait sport fishery, and by interception net fisheries in Johnstone and Juan de Fuca Straits (particularly in the San Juan Islands of Puget Sound). A significant incidental terminal gillnet catch, as well as sport and native food fisheries, also occur in the river.

18. Gillnet catches of coho in the Fraser River declined by 69%, and weight catches by 75%, since the early 1950's. Most of the mean annual (1951 - 1980) gillnet catch was made in September and October (85%). Seasonally, highest catches per delivery were made in September and

October (up to six fish). Landed coho weight ranged seasonally from 2.6 kg to 3.6 kg.

19. The coho troll fishery off the mouth of Fraser River (Area 29) is relatively insignificant, harvesting mixed Georgia Strait stocks.

20. The coho sport fishery within Fraser River harvests annually around 7,000 fish or about 5% of the mean annual (1969 - 1980) coho return to the river. The Georgia Strait sport fishery may harvest about 15% to 30% of the overall catch of Fraser River coho.

21. The Indian food fishery harvests annually over 20,000 Fraser River coho or about 16% of the mean annual (1969 - 1980) coho return to the river.

22. Outside exploitation of Fraser River coho is estimated to be very high, even without considering the terminal fisheries; two brood years of lower river stocks were harvested at rates of 82% and 87% with practically no terminal catch.

23. Spawning escapements of coho to the Fraser River fluctuated during the last 30 years, averaging annually around 69,000 fish. Enumeration of coho stocks is subject to considerable error since these fish spawn during periods of very difficult access and visual observation. Up-river stocks show a long-term decline, probably due to overexploitation and habitat deterioration. Lower river stocks show declines in the 1960's, followed by recoveries in the 1970's. This may be the result of conservation measures taken to preserve weak chum salmon runs, which have similar migration timing to lower rier coho stocks.

24. Total return of coho to the mouth of the Fraser River (escapement plus terminal catch) shows little trend with time, largely due to variable incidental catches of coho in the terminal fisheries and unreliable escapement data.

25. Environmental degradation (both natural and man-made) is decimating the salmonid rearing and spawning areas, and affects directly the area's productivity of chinook and coho salmon.

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Appendix 1. River migration rates of chinook and coho.

Chinook

The rates of travel of chinook in a free-flowing river are poorly known. Lister and Associates (MS 1981) recently reviewed the available literature on the upstream migration of salmonids, including their swimming rates and behaviour.

Chinook migrate during both day and night (Johnson 1960; Lister et al. 1971; Cleugh and Russell 1980), but most intensive swimming probably occurs during the daytime (Lister and Associates MS 1981). Armstrong and Hollett (MS 1970) combined fishwheel studies in the lower Fraser Canyon with dates of commercial fishery openings in the lower river and estimated adult chinook migration in the Fraser River at 24 km/day. This rate is similar to that reported for the lower Columbia River chinook (Schoning and Johnson (1956), but is lower than the rate observed in the upper Yukon (29 km/day) (Brock 1976) and in the lower Yukon River (39 km - 42 km/day) (Lebida 1969; Trasky 1973). The above migration rates in the Columbia and Yukon Rivers are probably underestimated due to effects of tagging on experimental fish (Lebida 1969). Johnson (1960) estimated the average migration speed of radio-tagged chinook in the Columbia River at 0.5 m/sec or 48 km/day. This figure includes the slower night migration rate.

Fraser River sockeye migrate at rates ranging from 27 km/day for the mid-river stocks, such as Adams River, to 48 km/day for the most up-river stocks, such as Bowron River (Killick 1955). Interviews with local Fraser River gillnet fishermen indicate that chinook salmon move more slowly and more erratically than the sockeye. The common "knowledge" among the Fraser River gillnetters, when the chinook fishery was open for more than one day per week, was that good catches of fish would proceed up the river at a rate of 16-20 km per day; i.e. good catches at Woodward Island would be followed by good catches at Port Mann bridge about a day later, and would occur in Albion area the following day (A. Baker, Fraser River gillnet fisherman, pers. comm.). The above limited data indicate that an estimate of chinook migration rates of 20-30 km per day in a free-flowing river may be reasonable.

An interesting case illustrating the possible speed of chinook migration comes from tagging studies by Parker and Kirkness (1956) off Sitka in southeast Alaska. A large five-year old female was tagged there on August 3, 1950, then recovered the same year on the North Thompson River spawning grounds. Given that the average spawning timing for this stock is early October, this fish should have entered the Fraser River by the end of August and should have arrived on the spawning grounds by the end of September. The 1,500 km from Sitka to the mouth of Fraser River represent 28 days of sustained travel at a rate of 50 km per day. The additional 600 km from the river mouth to the spawning grounds could be covered by the end of September, given a migration rate of 20 km per day. These minimum possible migration rates, required to bring the fish to the spawning grounds in time for early October spawning, would have to be sustained for a period of nearly 60 days. Earlier arrival would require a correspondingly faster migration rate.

Coho

Even fewer data on migration rates are available for coho, compared to chinook. Ellis (1966) measured instantaneous speeds of coho travelling during their spawning migration in a western Vancouver Island river. Over a range of opposing current velocities (mean 0.24 m/sec; range 0.15 m/sec - 0.43 m/sec), coho averaged a 0.75 m/sec swimming speed for a net migration rate of 0.5 m/sec. These observations were made in clear water over a 10 m distance just after the adult coho emerged from a rapids sequence. If such speeds could be maintained for 24 hours, a coho might travel over 40 km per day. Although this is unlikekly, migration rates in the range of 20 to 30 km per day (as for chinook) are probably reasonable.

Appendix 2a. Age composition of combined red and white chinook salmon from Fraser River gillnet fishery, 1952-1978.[a]

Year	References[b]	Number in each age class									Total	Percent in each age class								
		2_1	3_1	3_2	4_1	4_2	5_1	5_2	6_1	6_2	n	2_1	3_1	3_2	4_1	4_2	5_1	5_2	6_1	6_2
1952	A	12	5	6	9	3	0	0	0	0	35	34.3	14.3	17.1	25.7	8.6	0	0	0	0
1953	A	14	35	16	18	12	2	6	0	0	103	13.6	34.0	15.5	17.5	11.7	1.9	5.8	0	0
1954	A	2	13	9	11	4	0	1	0	0	40	5.0	32.5	22.5	27.5	10.0	0	2.5	0	0
1955	A	4	26	16	12	13	0	0	0	0	71	5.6	36.6	22.5	16.9	18.3	0	0	0	0
1956	A	15	177	22	120	15	17	3	2	1	372	4.0	47.6	5.9	32.3	4.0	4.6	0.8	0.5	0.3
1957	A	40	60	56	106	35	5	14	0	0	316	12.7	19.0	17.7	33.5	11.1	1.6	4.4	0	0
1958	A	3	64	20	112	83	13	69	0	4	368	0.8	17.4	5.4	30.4	22.6	3.5	18.8	0	1.1
1959	A	0	15	2	122	58	17	76	0	3	293	0	5.1	0.7	41.6	19.8	5.8	25.6	0	1.0
Sub-total 1952-1959		90	395	147	510	223	54	169	2	8	1,598	5.6	24.7	9.2	31.9	14.0	3.4	10.6	0.1	0.5
1964	B	256	851	210	1,326	1,059	76	890	0	8	4,676	5.5	18.2	4.5	28.4	22.6	1.6	19.0	0	0.2
	C	1	14	1	89	31	14	47	1	0	198	0.5	7.1	0.5	44.9	15.7	7.1	23.7	0.5	0
1965	C	8	72	13	163	67	39	38	1	2	403	2.0	17.9	3.2	40.4	16.6	9.7	9.4	0.2	0.5
	D	41	511	224	1,135	1,121	185	843	0	39	4,099	1.0	12.5	5.5	27.7	27.3	4.5	20.6	0	1.0
1966	C	15	84	12	207	99	15	56	3	2	493	3.0	17.0	2.4	42.0	20.1	3.0	11.4	0.6	0.4
	E	62	692	34	1,026	497	79	282	0	3	2,675	2.3	25.9	1.3	38.4	18.6	3.0	10.5	0	0.1
1969	F	40	900	41	458	439	98	277	0	5	2,258	1.8	39.9	1.8	20.3	19.4	4.3	12.3	0	0.2
Sub-total 1964-1969		423	3,124	535	4,404	3,313	506	2,433	5	59	14,802	2.9	21.1	3.6	29.8	22.4	3.4	16.4	0	0.4
1975	G	3	141	0	194	72	15	29	0	1	455	0.7	31.0	0	42.6	15.8	3.3	6.4	0	0.2
1976	G	0	92	0	267	22	13	34	0	1	429	0	21.5	0	62.6	5.1	3.0	7.9	0	0.2
1977	G	75	611	1	563	110	36	55	0	0	1,451	5.2	42.1	0.1	38.8	7.6	2.5	3.8	0	0
1978	G	73	211	2	685	31	47	76	0	3	1,068	1.2	19.8	0.2	64.1	2.9	4.4	7.1	0	0.3
Sub-total 1975-1978		91	1,055	3	1,709	235	111	194	0	5	3,403	2.7	31.0	0.1	50.2	6.9	3.3	5.7	0	0.1
Total		604	4,574	685	6,623	3,771	671	2,796	7	72	19,803	3.1	23.1	3.5	33.4	19.0	3.4	14.1	0	0.4

[a] Commercial gillnet samples taken from cannery fish and subject to bias due to the restricted net sizes used and limited fishing days available; test fishing samples came from DFO test boat using graded mesh size net, fishing four to five days a week; in both cases, samples were generally taken from May to September.

[b] A – Milne (1964b): commercial gillnet; B – Ball and Godrey (1967): commercial gillnet; C – Godrey (1968b): DFO test-fishing; D – Ball and Godfrey (1968a): commercial gillnet; E – Ball and Godrey (1968b): commercial gillnet; F – Ball and Godfrey (1970): commercial gillnet; G – unpublished data; Field Services Branch (commercial gillnet).

Appendix 2b. Age composition of red chinook salmon from Fraser River gillnet fishery, 1957-1978.[a]

Year	References[b]	Number in each age class									Total	Percent in each age class								
		2_1	3_1	3_2	4_1	4_2	5_1	5_2	6_1	6_2	n	2_1	3_1	3_2	4_1	4_2	5_1	5_2	6_1	6_2
1957	A	17	30	41	49	24	2	5	0	0	168	10.1	17.6	24.4	29.2	14.3	1.2	3.0	0	0
1958	A	0	16	17	35	59	5	50	0	2	184	0	8.7	9.2	19.0	32.1	2.7	27.2	0	1.1
1959	A	0	11	1	58	50	6	63	0	3	192	0	5.7	0.5	30.2	26.0	3.1	32.8	0	1.6
Sub-total 1957-1959		17	57	59	142	133	13	118	0	5	544	3.1	10.5	10.8	26.1	24.4	2.4	21.7	0	0.9
1964	B	107	459	157	807	844	37	583	0	4	2,998	3.6	15.3	5.2	26.9	28.2	1.2	19.4	0	0.1
	C	0	10	1	33	21	2	30	1	0	98	0	10.2	1.0	33.7	21.4	2.0	30.6	1.0	0
1965	C	6	39	11	86	62	13	28	1	2	248	2.4	15.7	4.4	34.7	25.0	5.2	11.3	0.4	0.8
	D	29	329	204	536	964	110	614	0	26	2,812	1.0	11.7	7.3	19.1	34.3	3.9	21.8	0	0.9
1966	C	1	48	10	100	84	8	49	2	2	304	0.3	15.8	3.3	32.9	27.6	2.6	16.1	0.7	0.7
	F	41	560	24	668	436	49	207	0	2	1,987	2.1	28.2	1.2	33.6	21.9	2.5	10.4	0	0.1
1969	F	32	713	36	347	369	66	201	0	3	1,767	1.8	40.4	2.0	19.6	20.9	3.7	11.4	0	0.2
Sub-total 1964-1969		216	2,158	443	2,577	2,780	285	1,712	4	39	10,214	2.1	21.1	4.3	25.2	27.2	2.8	16.8	0	0.4
1975	G	3	140	0	183	68	15	27	0	1	437	0.7	32.0	0	41.9	15.6	3.4	6.2	0	0.2
1976	G	0	86	0	246	19	9	32	0	1	393	0	21.9	0	62.6	4.8	2.3	8.1	0	0.3
1977	G	60	438	1	343	81	19	32	0	0	974	6.2	45.0	0.1	35.2	8.3	2.0	3.3	0	0
1978	G	2	157	2	502	31	22	72	0	3	791	0.3	19.8	0.3	63.5	3.9	2.8	9.1	0	0.4
Sub-total 1975-1978		65	821	3	1,274	199	65	163	0	5	2,595	2.5	31.6	0.1	49.1	7.7	2.5	6.3	0	0.2
Total		298	3,036	505	3,993	3,112	363	1,993	4	49	13,353	2.2	22.7	3.8	29.9	23.3	2.7	14.9	0	0.4

[a] See Append. 2a, footnote "a".
[b] See Append. 2a, footnote "b".

Appendix 2c. Age composition of white chinook salmon from Fraser River gillnet fishery, 1957-1978.[a]

Year	References[b]	Number in each age class									Total	Percent in each age class								
		2_1	3_1	3_2	4_1	4_2	5_1	5_2	6_1	6_2	n	2_1	3_1	3_2	4_1	4_2	5_1	5_2	6_1	6_2
1957	A	23	30	15	57	11	3	9	0	0	148	15.5	20.3	10.1	38.5	7.4	2.0	6.1	0	0
1958	A	3	48	3	77	24	8	19	0	2	184	1.6	26.1	1.6	41.8	13.0	4.3	10.3	0	1.1
1959	A	0	4	1	64	8	11	13	0	0	101	0	4.0	1.0	63.4	7.9	10.9	12.9	0	0
Sub-total 1957-1959		26	82	19	198	43	22	41	0	2	433	6.0	18.9	4.4	45.7	9.9	5.1	9.5	0	0.5
1964	B	149	392	53	519	215	39	307	0	4	1,678	8.9	23.4	3.2	30.9	12.8	2.3	18.3	0	0.2
	C	1	4	0	56	10	12	17	0	0	100	1.0	4.0	0	56.0	10.0	12.0	17.0	0	0
1965	C	2	33	2	77	5	26	10	0	0	155	1.3	21.3	1.3	49.7	3.2	16.8	6.5	0	0
	D	12	182	20	599	157	75	229	0	13	1,287	0.9	14.1	1.6	46.5	12.2	5.8	17.8	0	1.0
1966	C	14	36	2	107	15	7	7	1	0	189	7.4	19.0	1.1	56.6	7.9	3.7	3.7	0.5	0
	E	21	132	10	358	61	30	75	0	1	688	3.1	19.2	1.5	52.0	8.9	4.4	10.9	0	0.1
1969	F	8	187	5	111	70	32	76	0	2	491	1.6	38.7	1.0	22.6	14.3	6.5	15.5	0	0.4
Sub-total 1964-1969		207	966	92	1,827	533	221	721	1	20	4,588	4.5	21.1	2.0	39.8	11.6	4.8	15.7	0	0.4
1975	G	0	1	0	11	4	0	2	0	0	18	0	5.6	0	61.1	22.2	0	11.1	0	0
1976	G	0	6	0	21	3	4	2	0	0	36	0	16.7	0	58.3	8.3	11.1	5.6	0	0
1977	G	15	173	0	220	29	17	23	0	0	477	3.1	36.3	0	46.1	6.1	3.6	4.8	0	0
1978	G	11	54	0	183	0	25	4	0	0	277	4.0	19.5	0	66.1	0	9.0	1.4	0	0
Sub-total 1975-1978		26	234	0	435	36	46	31	0	0	808	3.2	29.0	0	53.8	4.5	5.7	3.8	0	0
Total		259	1,282	111	2,460	612	289	793	1	22	5,829	4.4	22.0	1.9	42.2	10.5	5.0	13.6	0	0.4

[a] See Append. 2a, footnote "a".
[b] See Append. 2a, footnote "b".

Appendix 3. Summary of major management regulations imposed on Area 29 gillnet fishery, 1951-1981.[a]

Gillnet Fishery							IPSFC Control Dates[c]		
			Days Fishing per Week						
Opening date		Effective Closing date[b]	Before IPSFC control	During IPSFC control	After IPSFC control	Total days fishing	From	To	Strikes
1951	Feb. 1	Nov.23	5	3-5	2-4	187.0	Jul. 2	Sept.27	No
1952	Feb. 1	Nov.28	4-5	3-5	4	189.0	Jun.30	Sept.29	July 21-July 24;Sept. 6-Oct.20
1953	Feb. 1	Nov.27	4-5	3-4	0-4	167.5	Jun.26	Sept.22	June 13-June 24
1954	Feb. 1	Nov.27	4-5	3-5	0-2	175.5	Jun.24	Sept.27	June 20-June 27;Aug. 7- Aug.14
1955	Feb. 1	Nov.11	4	3-4	1-4	141.0	Jun.30	Sept.25	No
1956	Feb. 1	Nov.15	4	2-3	2-4	138.0	Jun.28	Sept.19	No
1957	Feb. 1	Nov.18	4	1-3	0-4	129.0	Jun.26	Oct. 11	June 22-July 15;Oct. 5- Oct.15
1958	Feb. 1	Nov.12	4	3	0-4	124.0	Jun.23	Oct. 7	No
1959	Feb. 1	Dec. 4	4	3	0-4	138.0	Jun.21	Oct. 11	July 25 - Aug. 9
1960	Feb. 1	Nov. 2	4	1-3	0-2	120.0	Jun.27	Sept.26	No
1961	Feb. 1	Dec. 7	4	2	0-2	113.0	Jun.25	Oct. 8	No
1962	Feb. 1	Nov.21	4	1-3	0-2	107.0	Jun.24	Oct. 8	No
1963	Feb. 1	Nov.21	2-4	1-4	0-2	108.0	Jun.30	Oct. 12	July 13 - Aug. 4
1964	Feb. 1	Nov.26	2	1-3	0-2	96.0	Jun.28	Sept.26	No
1965	Mar.15	Oct.13	2	1-3	0-1	53.0	Jun.27	Oct. 4	No
1966	Mar.16	Oct. 5	2	1-3	0-1	51.0	Jun.26	Oct. 2	No
1967	Mar.16	Nov.22	4	1-4	0-1	88.0	Jun.25	Oct. 14	No
1968	Mar.18	Nov.27	2	½-3	0-1	61.0	Jun.30	Sept.21	No
1969	Mar.17	Nov.26	2	½-2	0-1	48.0	Jun.26	Oct. 11	No
1970	Mar.16	Nov.26	2	½-2	0-1	51.0	Jun.28	Oct. 11	No
1971	Mar.16	Oct.12	2	1-4½	0-½	63.0	Jun.27	Oct. 13	June 16 - July 7
1972	Mar.20	Dec. 1	2	½-2	1	51.0	Jun.25	Sept.24	No
1973[d]	Mar.19	Nov.27	2	1-4	1-1½	58.3	Jun.24	Oct. 14	July 6 - July 15
1974[e]	Mar.18	Nov. 6	2	1-3	0-1	47.3	Jun.23	Oct. 6	No
1975[f]	Mar.17	Oct.27	1	1-3	0-1	43.7	Jun.26	Oct. 9	July 28 - Aug. 24
1976[g]	Apr.19	Nov. 1	1	½-2.7	0-1	28.9	Jun.27	Oct. 7	No
1977[h]	Apr.18	Oct. 5	1	1-2	0-1	28.8	Jun.27	Oct. 9	No
1978[i]	Apr.17	Oct.30	1	0-2	0-1	22.9	Jun.25	Oct. 12	July 16 - July 22
1979[j]	Apr.23	Oct. 2	1	0-2	0-1	17.5	Jun.24	Oct. 6	No
1980[k]	Apr.21	Oct.20	1	0-2	0-1	23.8	Jun.22	Oct. 11	No
1981	Jul. 2	Sep.14	0	0-2	0	15.0	Jun.21	Oct. 11	No

[a] From: Area 29 History (DFO, unpublished data).

[b] Last day of net fishing for the year.

[c] International Pacific Salmon Fisheries Commission; Areas 29B-D.

[d] Maximum size gillnet allowed: 14.6 cm (5-3/4 in.) July 31 to Sept. 30 (raised to 16½ cm, Aug. 26).

[e] Maximum size gillnet allowed: 14.9 cm (5-7/8 in.), June 30 to Aug. 10 (rescinded July 7 to July 13).

[f] No maximum gillnet size.

[g] Maximum size gillnet allowed: 14.9 cm (5-7/8 in.), July 20 to Sept. 12.

[h] Maximum size gillnet allowed: 14.9 cm (5-7/8 in.), July 17 to Oct. 30 (rescinded Sept. 4-10).

[i] Maximum size gillnet allowed: 14.9 cm (5-7/8 in.), July 9 to Oct. 2.

[j] Maximum size gillnet allowed: 14.9 cm (5-7/8 in.), July 21 to Oct. 6; total closure May 30 to July 21.

[k] Maximum size gillnet allowed: 14.0 cm (5½ in.), July 2 to Sept. 14; total closure May 28 - July 14.

Appendix 4. Annual chinook gillnet and troll landed weight and effort, Area 29, 1951-1980.

	GILLNET		TROLL	
YEAR	LANDED WEIGHT (X 10^3 KG)[a]	EFFORT (DELIV)	LANDED WEIGHT (X 10^3 KG)[b]	EFFORT (BOAT-DAYS)
1951	1153	82614	0	10
1952	948	61684	0	3
1953	1386	66055	1	8
1954	1476	70194	N/A	9
1955	1032	46750	5	178
1956	970	39667	4	184
1957	702	38460	10	222
1958	1160	59038	5	143
1959	1261	46614	6	305
1960	909	39242	11	374
1961	692	41039	9	409
1962	753	33371	6	242
1963	774	36999	7	470
1964	1257	36193	9	310
1965	666	28824	4	116
1966	737	26060	5	175
1967	894	39193	13	708
1968	800	31235	6	218
1969	619	28487	3	323
1970	882	30652	19	657
1971	933	42835	17	497
1972	1030	26109	5	145
1973	749	28143	14	512
1974	517	19392	44	1051
1975	532	18582	45	1660
1976	603	17012	7	266
1977	670	23585	20	785
1978	455	16273	18	1248
1979	409	16033	9	906
1980	225	10533	1	50
1951-55	1199	65459	2	42
1956-60	1001	44604	7	246
1961-65	828	35285	7	309
1966-70	786	31125	9	416
1971-75	752	27012	25	773
1976-80	472	16687	11	651
1951-80	840	36696	10	406

[a] Round (whole) weight.

[b] Dressed weight (gutted with head left on).

Appendix 5. Average monthly gillnet catch of chinook, catch per delivery (CPUE), weight per fish, and percent of seasonal catch taken per month in Area 29 over five-year intervals, 1951-1980.[a]

YEAR		FEB.	MAR.	APR.	MAY.	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.	TOTAL
1951-55	PIECES	82	1007	6781	10253	21029	26996	31567	45086	11522	339		154662
	CPUE	0.86	2.03	2.88	3.19	5.03	2.47	2.27	3.78	1.09	0.05		2.42
	AV. WGT.	7.74	7.14	5.70	7.12	7.93	6.79	7.34	7.86	10.18	5.55		7.71
	% CATCH	0.05	0.65	4.44	6.72	14.11	17.53	20.98	28.58	6.71	0.21		100.00
1956-60	PIECES	34	588	4500	8570	20276	26092	31847	42508	5190	248	41	139861
	CPUE	3.77	2.13	2.96	3.37	4.95	3.67	2.96	4.73	0.83	0.14	0.02	3.15
	AV. WGT.	7.39	6.51	5.48	6.09	7.30	7.06	6.25	8.02	8.40	4.83	4.43	7.14
	% CATCH	0.02	0.40	3.20	6.08	14.45	18.69	22.58	30.67	3.72	0.18	0.02	100.00
1961-65	PIECES	69	706	4279	8320	20868	26247	28552	20031	3282	57	30	112403
	CPUE	0.75	1.75	2.59	2.89	4.39	4.32	3.24	4.65	0.91	0.06	0.01	3.21
	AV. WGT.	8.44	6.44	5.74	6.29	7.60	7.34	6.88	8.67	9.22	5.07	4.54	7.34
	% CATCH	0.05	0.53	3.65	7.54	19.00	23.56	24.68	18.11	2.84	0.05	0.03	100.00
1966-70	PIECES		201	2823	5198	16214	30090	28713	16584	5030	167		105020
	CPUE		2.46	2.81	2.79	4.53	3.99	3.77	4.16	1.74	0.11		3.40
	AV. WGT.		6.97	6.08	6.61	8.07	7.76	6.75	7.59	9.06	4.86		7.49
	% CATCH		0.20	2.72	4.99	15.79	28.73	27.17	15.59	4.66	0.15		100.00
1971-75	PIECES		168	1527	3883	9365	21744	19825	25232	16071	80		97895
	CPUE		2.25	2.83	3.66	4.73	3.95	3.32	4.26	3.79	0.43		3.71
	AV. WGT.		7.23	6.59	6.76	7.96	8.02	6.99	6.55	9.13	4.72		7.66
	% CATCH		0.19	1.64	4.07	9.20	23.17	20.11	24.96	16.56	0.09		100.00
1976-80	PIECES			1029	3170	7564	15099	13648	17117	5436	7		63070
	CPUE			3.86	4.42	7.28	4.40	2.67	4.53	2.96	0.15		3.76
	AV. WGT.			7.25	7.37	8.30	8.25	6.96	6.31	8.75	4.76		7.41
	% CATCH			1.80	5.37	11.99	21.58	22.44	28.15	8.66	0.01		100.00
1951-80[b]	PIECES	62	534	3490	6566	15886	24378	25692	27760	7755	173	36	112152
	CPUE	1.80	2.12	2.99	3.39	5.15	3.80	3.04	4.35	1.89	0.16	0.00	3.28
	AV. WGT.	7.86	6.86	6.14	6.71	7.86	7.54	6.86	7.50	9.12	5.04	4.48	7.46
	% CATCH	0.04	0.39	2.91	5.80	14.09	22.21	23.00	24.34	7.19	0.14	0.03	100.00

[a] See Append. 3 for start and end of Area 29 gillnet season by year.

[b] Mean of 5-year means.

Appendix 6. Weekly indices of chinook abundance in Fraser River, as measured by weekly catch per boat-day in Area 29D (Pattulo Bridge to Mission), 1969-1978.[a]

Statistical week	1969	1970	1971	1972	1973	Mean 1969-73[b]	1974[c]	1975[c]	1976	1977[c]	1978[c]	Mean 1974-78[b]
March 3	0.7	0.6	2.1	–	–	1.1	1.8	1.6	–	–	–	1.7
4	1.0	0.9	0.8	0.4	0.8	0.8	1.5	0.6	–	–	–	1.1
April 1	1.1	2.0	1.0	0.4	1.9	1.3	1.1	1.3	–	–	–	1.2
2	1.6	1.4	1.8	1.8	0.9	1.5	1.5	1.1	–	–	–	1.3
3	1.4	1.4	2.4	1.3	2.4	1.8	2.9	2.8	–	–	2.8	2.8
4	2.9	2.4	2.0	1.9	2.6	2.4	1.5	1.6	2.3	3.3	3.4	2.4
5	7.5	2.3	2.3	2.8	3.5	3.7	1.8	2.0	5.7	4.5	7.1	4.2
May 1	3.7	2.5	3.3	2.1	5.7	3.5	3.8	7.0	3.1	4.9	7.1	5.2
2	3.1	2.3	5.1	4.6	2.3	3.5	3.5	4.7	1.8	8.3	4.2	4.5
3	3.5	4.1	2.8	1.4	2.9	2.9	9.2	2.7	1.9	5.3	4.0	4.6
4	4.4	2.6	4.3	2.5	1.1	3.0	3.1	6.3	8.6	6.6	4.9	5.9
June 1	5.5	5.1	4.8	2.7	3.9	4.4	3.2	8.7	7.6	6.5	3.7	5.9
2	4.8	2.5	5.0	2.8	4.5	3.9	–	4.6	14.7	4.7	5.6	7.4
3	5.9	5.9	5.5	3.4	1.1	4.4	4.5	12.8	6.8	6.1	15.0	9.0
4	6.9	8.0	9.5	4.7	5.2	6.9	9.5	14.6	12.2	12.6	–	12.2
July 1	8.4[d]	13.2[d]	–	10.5[d]	2.5	8.7	16.8	9.9	22.9[d]	11.1	29.7[d]	18.1
2	15.7[d]	11.8[d]	11.6[d]	13.3	14.3	13.3	9.5	6.1	24.6[d]	8.6	–	12.2
3	4.4	12.8	9.1	12.1[d]	–	9.6	9.6	3.3	–	5.7	21.7	10.0
4	3.4	3.5	5.5	12.2	3.4	5.6	8.2	7.4	19.4	5.8	6.0	9.4
5	2.0	4.3	7.1	11.0	3.6	5.6	11.8	3.4	12.8	10.0	8.9	9.4
Aug. 1	4.4	8.8	6.8	5.0	2.2	5.4	7.2	1.4	7.9	3.0	–	4.9
2	5.2	9.5	4.4	4.0	4.8	5.6	6.1	2.2	–	2.4	6.1	4.4
3	4.8	7.5[d]	10.7	3.7	3.0	5.9	6.2	20.4	8.0	3.3	7.4	9.1
4	8.9	26.5[d]	5.1	5.3	6.2	10.4	4.9	11.5	5.6	4.8	6.9	6.7
Sept. 1	11.5[d]	13.2[d]	6.9	4.2	3.7	7.9	4.6	12.3	7.7	5.3	6.0	7.2
2	–	4.8	9.1	4.9	4.4	5.8	–	4.8	11.6	6.4	8.8	7.9
3	–	–	10.8	7.0	–	8.9	–	–	–	–	–	–
4	5.3[d]	–	–	16.1	–	10.7	–	26.2[d]	–	29.3	–	27.8
Oct. 1	9.5[d]	13.4[d]	11.2[d]	19.1	13.3	13.3	18.0	11.4	22.6[d]	–	13.2	16.3
2	0.9	2.4	1.7	13.5	31.1	9.9	–	–	–	20.2	–	20.2
3	–	0.4	1.3	4.3	5.5	2.9	–	–	3.3	–	–	3.3
4	–	–	–	–	–	–	–	1.6	–	–	1.0	1.3
5	–	–	–	0.5	1.1	0.8	–	–	0.5	–	–	0.5
Nov. 1	–	–	–	–	–	–	0.4	–	–	–	–	0.4

[a] When there was more than one day of fishing in a week, only the catch from the first day was used. Weeks in which there were strikes or Area 29D was closed are left blank.

[b] Weeks without indices are omitted from the averages.

[c] Mesh restrictions in force. See Append. 3 for dates.

[d] Twelve-hour spring opening with 20.3 cm (8 in.) or 21.6 cm (8½ in.) minimum mesh size. Twelve-hour catch is arbitrarily assumed to be 2/3 of a twenty-four hour catch.

Appendix 7. Average monthly troll catch of chinook, catch per boat-day, weight per fish, and percent of seasonal catch taken per month in Area 29 over five-year intervals, 1951-1980.

Period		Jan.	Feb.	Mar.	Apr.[a]	May	June	July	Aug.	Sept.	Oct.	Nov.[a]	Dec.	Total
1951-1955	Total catch (pieces)	36	103	7	1	5	5	1[b]	0	1	0	2	205	364
	Catch/boat day	18.0	8.6	3.5	0	2.5	2.5	—		--		2.0	10.3	8.7
	Average weight per fish (kg)	3.78	3.52	6.48	~0	--	--	--		--		—	3.10	3.36
	% of total gear catch	9.9	28.3	1.9	0.3	1.4	1.4	0.3		0.3		0.5	56.3	100
1956-1960	Total catch (pieces)	117	129	178	13	254	57	2	4	278	538	698	596	2,865
	Catch/boat day	7.8	11.7	8.1	1.6	15.9	11.4	0.5	1.3	11.6	13.5	14.2	12.2	11.6
	Average weight per fish (kg)	2.71	2.81	3.06	3.49	2.50	3.18	--	—	1.96	2.02	2.86	2.44	2.49
	% of total gear catch	4.1	4.5	6.2	0.5	8.9	2.0	0.1	0.1	9.7	18.8	24.4	20.8	100
1961-1965	Total catch (pieces)	29	124	42	516	228	26	2	154	130	747	568	76	2,643
	Catch/boat day	4.8	10.3	5.3	10.8	7.6	6.5	1.0	4.8	3.3	10.2	13.2	6.9	8.6
	Average weight per fish (kg)	3.13	2.93	3.24	3.34	2.98	--	—	2.94	2.79	2.06	2.24	2.39	2.66
	% of total gear catch	1.1	4.7	1.6	19.5	8.6	1.0	0.1	5.8	4.9	28.3	21.5	2.9	100
1966-1970	Total catch (pieces)	0	0	0	1,281	2,130	93	11	169	84	163	8	0	3,938
	Catch/boat day				16.9	14.6	11.6	2.8	1.8	2.5	3.0	8.0		9.5
	Average weight per fish (kg)				2.19	2.28	2.93	—	2.42	2.16	1.95	--		2.27
	% of total gear catch				32.5	54.1	2.4	0.3	4.2	2.1	4.1	0.2		100
1971-1975	Total catch (pieces)	0	0	0	843	8,964	366	41	64	427	111	0	0	10,816
	Catch/boat day				13.0	21.7	12.6	5.9	1.1	2.4	4.4			14.0
	Average weight per fish (kg)				2.31	2.21	2.73	3.32	4.96	3.08	3.68			2.30
	% of total gear catch				7.8	82.9	3.4	0.4	0.6	3.9	1.0			100
1976-1980	Total catch (pieces)	0	0	0	463	2,422	351	62	530	232	~ 0	4	0	4,064
	Catch/boat day				22.0	16.6	11.0	3.9	1.6	3.0		0.2		6.3
	Average weight per fish (kg)				--	2.39	2.84	7.47[c]	3.58	4.05		--		2.70
	% of total gear catch				11.4	59.6	8.6	1.5	13.0	5.7		0.1		100
1951-1980[d]	Total catch (pieces)	30	59	38	520	2,334	150	20	154	192	260	213	146	4,115
	Catch/boat day	10.2	10.2	5.6	10.7	13.2	9.3	2.8	2.1	4.6	7.8	7.5	9.8	9.8
	Average weight per fish (kg)	3.21	3.09	4.26	2.83	2.47	2.92	—	3.48	2.81	2.43	--	2.64	2.63
	% of total gear catch	0.7	1.4	0.9	12.6	56.7	3.6	0.5	3.7	4.7	6.3	5.2	3.5	100

[a] See Append. 3 for explanation of duration of trolling season in Area 29.

[b] Data not available.

[c] Very high value, possibly due to error in data.

[d] Mean of 5-year means.

Appendix 8. Summary of releases of coded wire tagged Fraser River chinook, 1972-1980.

Code	Brood year	Stock	Release date	No. released
02 16 55	'77	Birkenhead River	7/78	14,793
02 17 61	'78	Birkenhead River	7/79	12,614
02 18 59	'79	Bowron River	7/80	28,890
02 21 16	'75	Chilcotin River	5/77 to 6/77	793
02 21 17	'76	Chilcotin River	7/77 to 8/77	49,565
02 21 19	'77	Chilko River	7/78	73,376
02 21 25	'77	Chilko River	7/78	75,915
02 16 02	'78	Chilko River	7/79	45,932
02 16 58	'78	Chilko River	7/79	149,523
02 21 21	'76	Deadman River	7/77 to 10/77	7,379
02 20 29	'77	Deadman River	7/78 to 9/78	5,138
02 01 01	'71	Harrison River	7/72	24,969
02 02 01	'71	Harrison River	7/72	42,257
02 16 25	'78	Lower Shuswap R.	6/79	122,285
02 16 38	'78	Lower Shuswap R.	6/79	18,543
02 16 01	'79	Lower Shuswap R.	6/80	45,959
02 17 55	'79	Lower Shuswap R.	6/80	12,421
02 20 31	'78	Nechako River	7/79	12,351
02 15 08	'75	Nicola River	9/76 to 10/76	3,792
02 20 47	'78	Nicola River	7/79	4,200
02 20 43	'78	Quesnel/Horsefly R.	7/79	29,146
02 18 20	'79	Quesnel River/Lake	8/80	18,260
02 15 06	'75	South Thompson R.	6/76 to 8/76	29,780
02 17 34	'78	Squamish River	5/79	72,115
02 18 12	'79	Stuart River	7/80	26,959
02 18 11	'79	Swift Creek	8/80	14,272
02 21 27	'77	Tete Jaune	6/79	547
02 19 22	'78	Tete Jaune	8/79	77,332
02 18 61	'78	Tete Jaune	8/80	320
02 18 13	'79	Tete Jaune	8/80	30,328
02 20 63	'79	Tete Jaune	8/80	10,097
02 20 28	'79	Willow River	8/80	4,672

Appendix 9. Annual coho gillnet and troll landed weight and effort, Area 29, 1951-1980.

YEAR	GILLNET		TROLL	
	LANDED WEIGHT (X 10^3 KG)[a]	EFFORT (DELIV)[b]	LANDED WEIGHT (X 10^3 KG)[c]	EFFORT (BOAT-DAYS)[d]
1951	505	70792	0	0
1952	273	49193	0	2
1953	238	54608	0	1
1954	435	57787	0	5
1955	230	38997	0	107
1956	465	31251	0	107
1957	134	32089	0	156
1958	255	49562	0	86
1959	173	36736	0	190
1960	190	31264	1	339
1961	119	30571	1	303
1962	247	23730	0	218
1963	113	25479	0	380
1964	495	25140	0	80
1965	146	22976	0	45
1966	119	21045	0	71
1967	99	31549	0	476
1968	235	24904	0	46
1969	85	21519	0	262
1970	391	24172	1	119
1971	190	36244	1	220
1972	265	22448	0	48
1973	191	24686	0	193
1974	83	16723	1	365
1975	142	16346	3	642
1976	39	14869	0	144
1977	105	20901	5	522
1978	158	13840	13	1027
1979	22	14234	4	705
1980	98	10515	0	23
1951-55	336	54275	0	23
1956-60	243	36180	0	176
1961-65	224	25579	0	205
1966-70	186	24638	0	195
1971-75	174	23289	1	294
1976-80	84	14872	5	484
1951-80	208	29806	1	229

[a] Round (whole) weight.
[b] Deliveries after June 30.
[c] Dressed weight (gutted with head left off).
[d] Boat-days after May 31.

Appendix 10. Average monthly gillnet catch of coho, catch per delivery, weight per fish, and percent of seasonal catch taken per month in Area 29 over five-year intervals, 1951-1980.

Period		June	July	August	September	October	Nov.-Dec.[a]	Total
1951-1955	Total catch (pieces)	10	592	11,523	39,936	39,453	4,907	96,421
	Catch/delivery	--[b]	0.1	0.8	3.2	4.3	0.8	1.8
	Average weight per fish (kg)	--	2.53	2.91	3.46	3.68	3.59	3.49
	% of total gear catch	<0.1	0.6	12.0	41.4	40.9	5.1	100
1956-1960	Total catch (pieces)	27	359	8,038	30,567	31,000	2,933	72,924
	Catch/delivery	--	<0.1	0.8	2.8	5.8	1.6	2.0
	Average weight per fish (kg)	1.68	2.65	2.72	3.22	3.61	3.51	3.34
	% of total gear catch	<0.1	0.5	11.0	41.9	42.5	4.0	100
1961-1965	Total catch (pieces)	3	479	4,431	27,773	28,605	852	62,143
	Catch/delivery	--	0.1	0.5	6.1	8.3	0.9	2.4
	Average weight per fish (kg)	--	2.56	2.57	3.41	3.97	3.78	3.60
	% of total gear catch	<0.1	0.8	7.1	44.7	46.0	1.4	100
1966-1970	Total catch (pieces)	3	652	2,214	24,688	24,858	2,484	54,898
	Catch/delivery	--	0.1	0.3	5.8	8.7	1.3	2.2
	Average weight per fish (kg)	--	2.57	2.64	3.12	3.74	3.36	3.38
	% of total gear catch	<0.1	1.2	4.0	45.0	45.3	4.5	100
1971-1975	Total catch (pieces)	1	713	3,009	22,816	27,023	1,122	54,684
	Catch/delivery	--	0.1	0.5	3.6	6.5	2.1	2.3
	Average weight per fish (kg)	--	2.48	2.55	2.86	3.54	3.48	3.19
	% of total gear catch	<0.1	1.3	5.5	41.7	49.4	2.1	100
1976-1980	Total catch (pieces)	6	945	2,884	18,188	7,589	78	29,690
	Catch/delivery	--	0.3	0.5	5.2	3.5	1.4	1.9
	Average weight per fish (kg)	--	2.79	2.61	2.72	3.19	--	2.93
	% of total gear catch	<0.1	3.2	9.7	61.3	25.6	0.3	100
1951-1980[c]	Total catch (pieces)	8	623	5,350	27,328	26,421	2,063	61,793
	Catch/delivery	--	0.1	0.6	4.5	6.2	1.2	2.1
	Average weight per fish (kg)	--	2.60	2.67	3.13	3.62	3.54	3.32
	% of total gear catch	<0.1	1.3	8.2	46.0	41.6	2.9	100

[a] See Append. 3 for the ending dates of the Area 29 gillnet season by year. Almost all of the catch is taken in November.
[b] Data not available.
[c] Mean of 5-year means.

Appendix 11. Weekly indices of coho abundance in Fraser River, as measured by weekly catch per boat-day in Area 29D (Pattulo Bridge to Mission), 1969-1978.[a]

Statistical week		1969	1970	1971	1972	1973	Mean 1969-73[b]	1974	1975	1976	1977	1978	Mean 1974-78[b]
August	1	--	--	--	--	0.2	0.2	0.2	--	0.7	--	--	0.5
	2	0.1	--	0.1	--	0.7	0.3	0.1	--	--	--	--	0.1
	3	0.1	--	0.3	0.1	--	0.2	--	--	0.1	0.1	0.1	0.1
	4	1.0	1.3	0.1	0.2	0.1	0.5	--	1.5	0.1	0.2	0.9	0.7
Sept.	1	3.6	13.4	0.7	2.4	0.4	4.1	1.4	5.6	0.1	2.8	6.6	3.3
	2	--	17.6	2.8	9.2	2.9	8.1	--	9.9	0.6	11.8	39.7	15.5
	3	--	--	4.0	16.5	--	10.3	--	--	--	--	--	--
	4	4.7	--	--	21.9	--	13.3	--	0.5	--	2.8	--	1.7
Oct.	1	4.8	30.5	1.6	19.7	4.6	12.1	9.1	9.1	1.8	--	6.7	6.7
	2	7.3	12.6	18.0	11.2	24.8	14.8	--	--	--	25.4	--	25.4
	3	--	22.3	--	12.5	14.5	16.4	--	--	2.6	--	--	2.6
	4	--	--	--	4.0	--	4.0	--	--	--	--	6.6	6.6
	5	--	--	--	--	8.8	8.8	--	10.4	1.3	--	--	5.9
Nov.	1	--	--	--	--	--	--	10.7	--	--	--	--	10.7
	2	1.0	--	--	--	--	1.0	--	--	--	--	--	--
	3	--	4.9	--	0.8	--	2.9	--	--	--	--	--	--
	4	1.0	1.7	--	--	--	1.4	--	--	--	--	--	--
Dec.	1	--	--	--	0.1	1.0	0.6	--	--	--	--	--	--

[a] When there was more than one day of fishing in a week, only the catch from the first day was used. Weeks in which there were strikes or Area 29D was closed are left blank.

[b] Weeks without indices are omitted from the averages.

Appendix 12. Average monthly troll catch of coho, catch per boat-day, weight per fish, and percent of seasonal catch taken per month in Area 29 over five-year intervals, 1951-1980.

Period		June	July	August	September	October	Nov.-Dec.[a]	Total
1951-1955	Total catch (pieces)	43	1	2	2	0	1	49
	Catch/boat-day	21.5	--[b]	--	2.0		< 0.1	2.1
	Average weight per fish (kg)	1.05	--	--	--		--	0.93
	% of total gear catch	87.8	2.0	4.1	4.1		2.0	100
1956-1960	Total catch (pieces)	75	0	3	26	9	3	116
	Catch/boat-day	15.0		1.0	1.1	0.2	< 0.1	0.7
	Average weight per fish (kg)	--		--	3.49	--	--	1.56
	% of total gear catch	64.7		2.6	22.4	7.8	2.6	100
1961-1965	Total catch (pieces)	0	1	36	36	39	2	114
	Catch/boat-day		0.5	1.1	0.9	0.5	< 0.1	0.6
	Average weight per fish (kg)		--	2.52	2.52	2.33	--	1.99
	% of total gear catch		0.9	31.6	31.6	34.2	1.8	100
1966-1970	Total catch (pieces)	0	3	114	18	33	0	169
	Catch/boat-day		0.8	1.2	0.5	0.6		0.9
	Average weight per fish (kg)		--	1.59	2.52	2.75		1.88
	% of total gear catch		1.8	67.5	10.7	19.5		100
1971-1975	Total catch (pieces)	0	45	100	337	51	0	533
	Catch/boat-day		6.4	2.7	1.9	2.0		1.8
	Average weight per fish (kg)		1.01	2.27	2.83	2.67		2.55
	% of total gear catch		8.4	18.8	63.2	9.6		100
1976-1980	Total catch (pieces)	10	293	958	463	7	100	1,831
	Catch/boat-day	0.3	17.0	2.8	6.1	3.4	5.7	3.8
	Average weight per fish (kg)	--	2.70	2.33	2.69	--	3.19	2.53
	% of total gear catch	0.5	16.0	52.3	25.3	0.4	5.5	100
1951-1980[c]	Total catch (pieces)	21	57	202	147	23	18	469
	Catch/boat-day	--	6.2	1.6	2.1	1.3	--	1.7
	Average weight per fish (kg)	--	--	2.18	2.81	2.58	--	1.91
	% of total gear catch	4.5	12.2	43.1	31.3	4.9	3.8	100

[a] See Append. 3 for explanation of duration of trolling season in Area 29. With the exception of November 1978, virtually no troll-caught coho have been landed in November or December for the entire 30-year period.

[b] Data not available.

[c] Mean of 5-year means.

Appendix 13. Summary of releases of coded wire tagged Fraser River coho, 1976-1980.

Code	Brood year	Stock	Release date	No. released	Major return year
12 01 13	'75	Chilliwack Lake	11/76	6,189	'78
02 15 11	'75	Chilliwack Lake	10/76 to 12/76	22,302	'78
02 16 27	'75	Chilliwack Lake	4/77 to 6/77	111	'78
02 21 20	'76	Chilliwack Lake	10/77 to 12/77	5,152	'79
02 21 30	'77	Chilliwack Lake	10/78 to 12/78	14,800	'80
02 17 60	'78	Chilliwack Lake/ Dolly Varden Creek	8/79 to 9/79	25,306	'81
02 15 13	'74	Chilliwack R.	4/76 to 6/76	19,607	'77
02 04 13	'75	Chilliwack R.	4/77 to 6/77	21,429	'78
02 21 24	'76	Chilliwack R.	4/78 to 6/78	36,012	'79
02 16 60	'77	Pitt River (upper)	9/79 to 11/79	19,087	'80
02 16 62	'78	Pitt River (upper)	9/79 to 11/79	62,505	'81
02 18 02	'78	Pitt River (upper)	9/80 to 10/80	15,663	'81
02 18 03	'79	Pitt River (upper)	9/80 to 10/80	70,749	'82
02 16 52	'76	Salmon River[a]	5/78 to 6/78	13,404	'79
02 16 59	'77	Salmon River[a]	5/79	32,147	'80
02 18 23	'78	Salmon River[a]	5/80 to 6/80	30,232	'81

[a] Below Hope.

Appendix 14. The delineation of administrative sub-districts in the Fraser River watershed, 1980.[a]

District No. 1 - above Boston Bar (head office, Kamloops).

Prince George sub-district: includes all of the Nechako-Stuart watershed and those salmon streams flowing into the Fraser River upstream from Hixon, B.C. until past the confluence with the Morkill R. The Bowron R. is included only up to its confluence with Indianpoint Cr.

Cariboo sub-district: includes the Fraser R. running from the confluence with Churn Cr. to Hixon, B.C. and all tributaries. This includes the Chilcotin system, the Westroad R., and the Quesnel R. The Bowron R. upstream from Indianpoint Cr. is also included.

Lillooet sub-district: includes the Fraser R. running from Boston Bar to Churn Cr. and all tributaries (except Gates Cr.). All of the Thompson R. downstream from Kamloops Lake and the Nicola R. are also included.

Kamloops sub-district: A very small sub-district with no salmon spawning beginning at the outlet of Kamloops Lake and continuing upstream past the confluence with the North Thompson R. to Campbell Cr. on the South Thompson R. The North Thompson R. downstream from Heffley Cr. is also included.

Salmon Arm sub-district: includes all waters draining into the South Thompson R. upstream from Campbell Cr. except most of the tributaries flowing into Adams L., including the upper Adams R. (This sub-district also includes the Okanagan R. in the Columbia R. drainage).

Clearwater sub-district: includes all waters draining into the North Thompson R. upstream from Heffley Cr. It also includes all the salmon streams flowing into Adams L. and those streams flowing into the uppermost reaches of the mainstem of the Fraser R. upstream from (and including) Goat R.

District No. 2 - below Boston Bar (head office, New Westminster).

Vancouver sub-district: includes only the north side of the North Arm of the Fraser downstream from the Knight St. bridge. (This sub-district also includes Burrard Inlet and Indian Arm).

Steveston sub-district: includes all of the delta of the Fraser R. seaward (west) of the north-south line intersecting the Knight St. bridge (except the north side of the North Arm).

Coquitlam sub-district: includes all of the north shore of the Fraser R., beginning at the Knight St. bridge on the North Arm and ending at Whonnock Cr. All tributaries, including the Pitt R., are also included.

Surrey sub-district: beginning where the Steveston sub-district leaves off, this sub-district includes all of the south side of the Fraser R. and its tributaries up to the Mission bridge. (This sub-district also includes tributaries to Boundary Bay).

Appendix 14 (cont'd).

Mission - Harrison sub-district: includes all of the north side of the Fraser R. and its tributaries, running from Whonnock Cr. to Ruby Cr. This sub-district also includes all of the Harrison - Lillooet watershed including the Birkenhead R. Gates Cr., flowing into Anderson L., is also included.

Chilliwack sub-district: beginning at the Mission bridge in Abbotsford, this sub-district includes all of the south of the Fraser R. and its tributaries up to Hope. The Vedder-Chilliwack R. is also included. The north side (after Hope, the west side) of the Fraser R. is also included in this sub-district upstream of Ruby Cr. This sub-district ends at Boston Bar where the Lillooet sub-district begins.

[a] From 1978 Annual Narrative Reports (DFO, File No. 5871 - BC 1-1) and from G. Scott (District No.2 supervisor, pers. comm.); last revision in 1978 by DFO.

Appendix 15a. Annual chinook escapements to upper Fraser River and its tributaries above Prince George, 1951-1980.

YEAR	BOWRON R.	FRASER R.	GOAT R.	HOLMES (BEAVER) R.	HORSEY CR.	MCGRE -GOR R.	MCKALE CR.	MOR-KILL CR.	NEVIN (KING) CR.	SALMON R.	SLIM CR.	SWIFT CR.	TORPY R.	WALKER CR.[a]	WEST TWIN CR.	WILLOW R.	TOTAL
1951	PRES	7500	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	PRES	7500
1952	500	7000	N/R	N/R	N/R	N/R	N/R	N/R	N/R	PRES	N/R	N/R	N/R	N/R	N/R	PRES	7500
1953	750	9000	N/R	N/R	N/R	N/R	N/R	N/R	N/R	PRES	N/R	N/R	N/R	N/R	N/R	PRES	9750
1954	750	6500	N/R	N/R	N/R	1500	N/R	N/R	N/R	PRES	N/R	N/R	N/R	N/R	N/R	200	8950
1955	400	4500	N/R	N/R	N/R	1250	N/R	N/R	N/R	PRES	N/R	N/R	N/R	N/R	N/R	200	6350
1956	400	4500	N/R	N/R	N/R	750	N/R	N/R	N/R	PRES	N/R	N/R	N/R	N/R	N/R	75	5725
1957	750	5500	N/R	N/R	N/R	750	N/R	N/R	N/R	PRES	N/R	N/R	N/R	N/R	N/R	PRES	7000
1958	1500	5500	N/R	N/R	N/R	900	N/R	N/R	N/R	500	N/R	N/R	N/R	N/R	N/R	250	8650
1959	400	1500	N/R	N/R	N/R	400	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	PRES	2300
1960	400	475	N/R	N/R	N/R	125	N/R	N/R	N/R	25	N/R	N/R	N/R	N/R	N/R	25	1050
1961	750	140	20[b]	40[b]	N/R	325	N/R	170	N/R	10	500	N/R	250	N/R	N/R	20	2225[d]
1962	1500	600[c]	N/R	400[b]	200[b]	750	N/R	400	200[b]	25	1500	N/R	1500	N/R	N/R	75	7150[e]
1963	400	1000	N/R	300[b]	100[b]	850	N/R	400	100[b]	50	500	N/R	600	N/R	N/R	100	4400
1964	750	1500	N/R	N/R	N/R	1100	N/R	N/R	N/R	200	1750	N/R	600	N/R	N/R	75	5975
1965	750	400	N/R	N/R	N/R	700	N/R	N/R	N/R	200	500	N/R	200	N/R	N/R	25	2775
1966	750	600	N/R	400[b]	N/R	500	N/R	N/R	N/R	125	700	N/R	350	N/R	N/R	40	3465
1967	400	750[f]	25[g]	400[h]	N/R	700	N/R	N/R	N/R	150	650	N/R	650	N/R	N/R	100	3825
1968	400	1350[f]	25[g]	400[h]	N/R	200	N/R	N/R	N/R	75	750	N/R	400	N/R	N/R	75	3675
1969	400	1300[f]	25[g]	25[h]	N/R	200	N/R	N/R	N/R	750	750	N/R	400	N/R	N/R	75	3925
1970	3500	1800	25[g]	75[h]	N/R	400	N/R	N/R	N/R	200	750	75	750	N/R	N/R	75	7650
1971	1200	1200	25[i]	275	25[i]	750	N/R	N/R	25	200	750	75	550	200	25	75	5375
1972	1300	1800	50[i]	250[i]	25	400	N/R	150	50[i]	200	750	200	400	200	N/R	75	5850
1973	1000[i]	1000	50[i]	100	10	750	N/R	275	25	400	750	75	750	200	N/R	75	5460
1974	1000	1200	55[i]	800[i]	30[i]	400	50	200	20[i]	750	750	175[i]	400	200	30	200	6260
1975	1200	1200[i]	11[i]	200	6[i]	400	N/R	200	11[i]	200	750	75	200	200	5	75	4733
1976	800	1800[i]	25	75	25	760	N/R	200	25	200	1422	150[i]	400	200	N/R	75	6157
1977	950	2000	20	150	N/O	1150	5	225	5[i]	200	1900	275	400	125	10	115	7530
1978	2000	3500	70[i]	675	40	730	20	200	30[i]	400	1600	200	200	150	N/R	200	10015
1979	1350	1800	15	450	25	1500	10	200	20	750	1500	350	750	200	25	750	9695
1980	2000	4000	85	500	20	1000	4	N/R	12	500	1900	350	550	250	N/R	500	11671
51-60	650	5198	N/R	N/R	N/R	811	N/R	N/R	N/R	263	N/R	N/R	N/R	N/R	N/R	150	6478
61-70	960	944	24	255	150	573	N/R	323	150	179	835	75	570	N/R	N/R	66	4507
71-80	1280	1950	41	348	23	784	18	206	22	380	1207	193	460	193	19	214	7275
76-80	1420	2620	43	370	28	1028	10	206	18	410	1664	265	460	185	18	328	9014

N/O=none observed; N/R=no record; PRES =present.

[a] Includes Wasna and Vama-Vama Creeks.

[b] From Upper Fraser R. spawning file.

[c] From 1966 spawning report for brood year.

[d] Fraser River Board estimated a total escapement of 10,200 to these rivers, based on catches of chinook and sockeye in a fishwheel at Shelley, B.C. (Fraser River Board, 1963).

[e] Fraser River Board estimate: 8,400.

[f] Includes Swift Cr.

[g] Includes Milk R. and West Twin Cr.

[h] Includes Nevin and Horsey Creeks.

[i] From Annual Narrative Report.

[j] Includes 400 in Indianpoint Cr.

Appendix 15b. Annual chinook escapements to Nechako River and its tributaries, 1951-1980.

YEAR	CHILAKO R.	DRIFTWOOD R.	ENDAKO R.	KAZCHEK CR.	KUZKWA CR.	MIDDLE R.	NADINA R.	NECHAKO R.	PINCHI CR.	ORMOND CR.	SAKENICHE R.	SOWCHEA CR.	STELLAKO R.	STUART R.	TACHIE R.	TOTAL
1951	PRES	N/R	N/R	N/R	N/R	N/R	N/R	3500	N/R	N/R	N/R	N/R	25	400	N/R	3925
1952	PRES	N/R	N/R	N/R	N/R	N/R	N/R	3500	N/R	N/R	N/R	N/R	N/R	750	N/R	4250
1953	250	N/R	N/R	75	75	N/R	N/R	400	N/R	N/R	75	N/R	75	1500	75	2525
1954	350	N/R	N/R	25	N/R	N/R	N/R	1500	N/R	N/R	N/R	N/R	25	75	25	2000
1955	PRES	N/R	N/R	N/R	N/R	N/R	N/R	400	N/R	N/R	N/R	N/R	25	400	N/R	825
1956	175	N/R	N/R	N/R	N/R	N/R	N/R	200	N/R	N/R	N/R	N/R	75	200	N/R	650
1957	125	N/R	N/R	75	75	N/R	N/R	PRES	N/R	N/R	N/R	N/R	75	200	25	575
1958	200	25	N/R	25	25	N/R	25	N/O	N/R	N/R	75	N/R	1500[a]	750	25	2650
1959	PRES	N/R	25	25	25	N/R	N/R	N/O	N/R	25	N/R	N/R	460	200	N/R	760
1960	25	3	6	N/O	N/O	25	N/R	75	N/R	4	N/R	N/R	120	75	7	340
1961	50	25	N/R	25	75	25	N/R	350	N/R	N/R	N/R	N/R	127	750[b]	25	1452
1962	25	25	25	N/R	75	25	25	400	N/R	N/R	N/R	N/R	200	200	25	1025
1963	40	N/R	25	N/R	25	25	N/R	400	N/R	N/R	N/R	N/R	400	350	25	1290
1964	75	25	25	N/R	25	25	N/R	700	N/R	25	N/R	N/R	200	400	N/R	1500
1965	50	25	25	N/R	25	25	N/R	400	N/R	N/R	N/R	N/R	75	60	N/R	685
1966	40	25	25	N/R	25	N/R	N/R	450	N/R	25	N/R	N/R	150	55	N/R	795
1967	60	N/R	25	N/R	75	25	N/R	750	25	N/R	N/R	N/R	77	200	25	1262
1968	75	6	25	25	25	25	N/R	400	N/R	N/R	N/R	N/R	75	200	N/R	856
1969	PRES	N/R	25	25	75	25	N/R	400	N/R	N/R	N/R	N/R	75	400	N/R	1025
1970	75	N/R	25	N/R	75	25	N/R	750	N/R	N/R	N/R	N/R	90	750	N/R	1790
1971	75	N/R	25	N/R	25	N/R	N/R	400	N/R	7	N/R	10	75	750	N/R	1367
1972	75	N/R	25	25	75	N/R	N/R	400	N/R	25	N/R	N/R	54	75	25	779
1973	200	N/R	25	25	200	12	N/R	750	N/R	N/R	N/R	N/R	25	200	N/R	1437
1974	200	N/R	25	25	200	25	N/R	1000[c]	N/R	N/R	N/R	N/R	75	400	N/R	1950
1975	75	N/R	25	N/R	75	N/R	N/R	1500	N/R	N/R	N/R	N/R	75	750	N/R	2500
1976	75	N/R	25	25	PRES	N/R	N/R	1200	N/R	25	N/R	N/R	80	225	N/R	1655
1977	200	N/R	25	25	200	N/R	N/R	2000	25	N/R	N/R	N/R	140	225	N/R	2840
1978	200	N/R	25	25	200	25	N/R	2600	25	25	N/R	N/R	75	1000	N/R	4200
1979	200	N/R	75	25	75	N/R	N/R	1800	25	N/R	N/R	N/R	75	750	N/R	3025
1980	200	N/R	50	N/R	25	N/R	N/R	2500	N/R	N/R	N/R	N/R	50	1800	N/R	4625
51-60	188	14	16	45	50	25	25	1368	N/R	15	75	N/R	264	455	31	1850
61-70	54	22	25	25	50	25	25	500	25	25	N/R	N/R	147	337	25	1168
71-80	150	N/R	33	25	119	21	N/R	1415	25	21	N/R	10	72	618	25	2438
76-80	175	N/R	40	25	125	25	N/R	2020	25	25	N/R	N/R	84	800	N/R	3269

N/O=none observed; N/R=no record; PRES =present.

[a] Diverted from Nechako R. because of dam construction.

[b] Estimated by Chatwin et al. (1962).

[c] From 1978 file for 1974 brood year.

Appendix 15c. Annual chinook escapements to Fraser River, Lillooet to Prince George, 1951-1980.

YEAR	CHILCO-TIN R.	CHILKO R.	COTTON-WOOD R.	ELKIN CR.	HORSE-FLY R.	QUESNEL R.	TASEKO R.	WEST-ROAD R.[a]	TOTAL
1951	400	500	100	N/R	130	1200	350	N/R	2680
1952	400	400	100	N/R	95	450	400	N/R	1845
1953	400	400	200	N/R	75	400	400	N/R	1875
1954	750	400	200	N/R	75	400	400	N/R	2225
1955	400	400	75	N/R	75	750	400	N/R	2100
1956	400	400	75	N/R	25	400	400	N/R	1700
1957	400	400	200	N/R	75	400	400	N/R	1875
1958	750	750	400	N/R	200	750	750	N/R	3600
1959	750	3500	75	N/R	75	750	750	N/R	5900
1960	400	400	75	N/R	75	400	400	750	2500
1961	400	400	200	N/R	200	400	400	N/R	2000
1962	750	1500	400	N/R	200	750	750	N/R	4350
1963	400	1500	75	N/R	75	750	400	N/R	3200
1964	1500	7500	75	N/R	400	1500	750	750	12475
1965	400	3500	75	N/R	200	2500	30	200	6905
1966	750	3500	200	N/R	200	750	400	200	6000
1967	700	4000	75	200	192	750	400	200	6517
1968	400	4500	75	N/R	200	1100	400	500	7175
1969	400	7000	75	N/R	200	1100	400	200	9375
1970	750	7500	200	N/R	750	1800	750	400	12150
1971	1500	4000	300[b]	300	200	900	100[b]	350[b]	7650
1972	850[b]	2000	300[b]	300	200	750	N/O	350[b]	4750
1973	800[b]	7000	300	200	200	1100	N/O	800	10400
1974	750	1500	200	100	75	1000	N/O	1800	5425
1975	850	11000	100	100	200	1000	350	1000	14600
1976	800[b]	6500	100[b]	350	300[b]	1000	50[b]	900	10000
1977	700	7000	150[b]	450	200	1400	N/O	1600	11500
1978	850	7500	100	350	300	1200	300[b]	1900	12500
1979	1500	3300	200	200	350	900	50	1500	8000
1980	1400	5000	300	250	350	1000	150	750	9200
51-60	505	755	150	N/R	90	590	465	750	2630
61-70	645	4090	145	200	262	1140	468	350	7015
71-80	1000	5480	205	260	238	1025	167	1095	9403
76-80	1050	5860	170	320	300	1100	138	1330	10240

N/O=none observed; N/R=no record; PRES =present.

[a] Includes Nazko and Bazaeko Rivers.

[b] From Annual Narrative Reports (DFO, unpublished).

Appendix 15d. Annual chinook escapements to North Thompson River and its tributaries, 1951-1980.

YEAR	BARRIERE R.	BLUE R.	CLEAR-WATER R.	FINN CR.	LEMIEUX CR.	LION CR.	LOUIS CR.	MCTAG-GART CR.	MAD R.	MAHOOD R.	MANN CR.	RAFT R.	NORTH THOMP-SON R.	TOTAL
1951	75	N/R	1500	400	75	N/R	200	N/R	25	N/R	N/R	400	750	3425
1952	PRES	N/R	200	400	25	N/R	200	N/R	N/R	N/R	N/R	400	400	1625
1953	400	N/R	N/R	3500	400	N/R	750	N/R	N/R	N/R	N/R	1500	3500	10050
1954	25	N/R	PRES	1500	200	N/R	750	N/R	N/R	N/R	N/R	200	3500	6175
1955	400	N/R	1500	400	N/O	N/R	400	N/R	N/R	N/R	25	400	PRES	3125
1956	N/O	N/R	PRES	1500	N/O	N/R	400	N/R	N/R	N/R	N/R	400	N/O	2300
1957	25	N/R	3500	1500	75	N/R	400	N/R	N/R	N/R	N/R	1500	PRES	7000
1958	25	N/R	3500	1500	25	N/R	750	N/R	N/R	N/R	N/R	200	PRES	6000
1959	200	N/R	1500	750	N/O	N/R	750	N/R	N/R	N/R	N/R	400	250	3850
1960	25	N/R	529[a]	25	25	N/R	400	N/R	N/R	N/R	N/R	200	1750[b]	2954
1961	25	N/R	5500[b]	22	N/O	N/R	400	N/R	N/R	N/R	N/R	200	1750[b]	7897
1962	75	N/R	4500[b]	750	75	N/R	400	N/R	N/R	N/R	N/R	200	1500[b]	7500
1963	75	N/R	1500	750	N/O	N/R	400	N/R	N/R	N/R	N/R	200	PRES	2925
1964	200	N/R	750	200	N/O	N/R	75	N/R	N/R	N/R	N/R	400	2500	4125
1965	400	N/R	750	750	N/O	N/R	N/O	N/R	N/R	N/R	N/R	750	3500	6150
1966	25	N/R	1500	400	N/O	N/R	25	N/R	N/R	N/R	N/R	400	1500	3850
1967	N/O	N/R	1500	500	N/O	N/R	100	N/R	N/R	N/R	N/R	200	1500	3800
1968	N/O	N/R	750	500	N/O	N/R	75	N/R	N/R	N/R	25	25	750	2125
1969	50	N/R	1500	750	N/O	25	25	N/R	N/R	N/R	N/R	200	1500	4050
1970	25	N/R	1500	750	N/O	N/R	25	N/R	N/R	200	N/R	75	1500	4075
1971	10	N/R	1500	750	N/O	N/R	200	N/R	N/R	136	N/R	200	1000	3796
1972	50[c]	N/R	1200[c]	300[c]	25	25	200	N/R	N/R	150	N/R	250[c]	1400[c]	3600
1973	N/O	N/R	1500	500[c]	N/O	N/R	50	N/R	N/R	500	N/R	260[c]	1000	3810
1974	10[c]	N/R	1200[c]	650[c]	N/O	N/R	40[c]	N/R	N/R	300	N/R	140[c]	1000	3340
1975	10[c]	N/R	1200[c]	296[c]	N/O	N/R	54[c]	N/R	N/R	179	N/R	121[c]	750	2610
1976	75	N/R	1550[c]	400	25	25	200	25	N/R	200	N/R	250[c]	2500[c]	5250
1977	10	N/R	2750[c]	525	N/O	N/R	60	N/R	N/R	425	N/R	230	2250	6250
1978	10[c]	N/R	3000[c]	700	N/O	30	75	N/R	N/R	450	N/R	200	2500	6965
1979	15	15	1500	425	N/O	N/R	20	N/R	N/R	260	N/R	175	1200	3610
1980	15	20	2500	600	10	2	45	10	N/R	150	N/R	200	750	4302
51-60	147	N/R	1747	1148	118	N/R	500	N/R	25	N/R	25	560	1692	4650
61-70	109	N/R	1975	537	75	25	169	N/R	N/R	200	25	265	1778	4650
71-80	23	18	1790	515	20	21	94	18	N/R	275	N/R	203	1435	4353
76-80	25	18	2260	530	18	19	80	18	N/R	297	N/R	211	1840	5275

N/O=none observed; N/R=no record; PRES =present.

[a] Count by Chatwin et al. (1961).

[b] Estimates by Chatwin et al. (1962) and Fraser River Board (1963).

[c] From Annual Narrative Reports (DFO, unpublished).

Appendix 15e. Annual chinook escapements to South Thompson River and its tributaries, 1951-1980.

YEAR	ADAMS R.	UPPER ADAMS R.[a]	BESSETT CR.	EAGLE R.	LITTLE R.	SALMON R.	SCOTCH CR.	SEYMOUR R.	LOWER SHUSWAP R.[b]	MIDDLE SHUSWAP R.[c]	SOUTH THOMPSON R.	TOTAL
1951	750	N/R	N/R	750	75	750	N/R	N/R	750	750	3500	7325
1952	3500	N/R	N/R	3500	400	1500	N/R	N/R	3500	1500	3500	17400
1953	3500	N/R	N/R	3500	750	750	N/R	PRES	7500	750	7500	24250
1954	1500	N/R	N/R	1500	750	PRES	N/R	400	1500	N/R	N/R	5650
1955	1500	N/R	N/R	400	75	200	N/R	N/R	3500	1500	25	7200
1956	1500	N/R	N/R	750	400	200	N/R	N/R	3500	1500	400	8250
1957	3500	N/R	N/R	1500	750	25	N/R	N/R	3500	1500	1500	12275
1958	1500	N/R	N/R	1500	1500	200	N/R	400	7500	750	3500	16850
1959	1500	N/R	N/R	750	200	200	N/R	75	1500	750	1500	6475
1960	1500	N/R	N/R	1500	200	200	N/R	N/R	3500	750	3500	11150
1961	1500	N/R	N/R	750	750	25	N/R	N/R	3500	1500	3500	11525
1962	1500	N/R	25	3500	750	400	N/R	400	3500	750	3500	14325
1963	1500	N/R	25	1500	400	200	N/R	200	3500	750	1500	9575
1964	400	25	25	400	750	75	N/R	N/R	3500	750	7500	13425
1965	1500	N/R	N/O	750	200	200	N/R	75	1500	400	3500	8125
1966	3500	N/R	N/O	750	400	200	N/R	25	3500	400	2000	10775
1967	1500	N/R	25	750	400	200	25	75	15000	1500	3500	22975
1968	3500	N/R	N/O	200	400	200	25	N/O	7500	400	3500	15725
1969	5000	N/R	N/O	400	200	200	N/R	25	7500	500	7500	21325
1970	1500	N/R	25	300	750	200	N/R	N/O	7500	750	7500	18525
1971	900[d]	N/R	25	750	200	400	N/R	N/O	7500	750	2100[d]	12625
1972	1900[d]	N/R	25	300	125[d]	200	N/R	N/R	4500[d]	300	5000	12350
1973	1700[d]	N/R	N/O	350[d]	200	150	N/R	N/R	9000[d]	400	5000	16800
1974	1700[d]	N/R	25	350[d]	300	250	N/R	N/R	10000	600[d]	4500[d]	17725
1975	1300[d]	N/R	25	300	400	200	N/R	N/R	17500[d]	600[d]	7000[d]	27325
1976	400	N/R	N/O	250	100	150	N/R	N/R	2500	400	1500	5300
1977	1750	N/R	15	756	600	300	N/R	25	9500	550	7000	20496
1978	2200	N/R	20	400	100	350	N/R	N/O	10400	350	3500	17320
1979	1000	N/R	50	300	700	300	N/R	10	10000	500	6000	18860
1980	350	N/R	50	250	400	360	N/R	N/R	4000	500	3000	8910
51-60	2025	N/R	N/R	1565	510	447	N/R	292	3625	1083	2769	11683
61-70	2140	25	25	930	500	190	25	133	5650	770	4350	14630
71-80	1320	N/R	29	401	313	266	N/R	18	8490	495	4460	15771
76-80	1140	N/R	34	391	380	292	N/R	18	7280	460	4200	14177

N/O=none observed; N/R=no record; PRES =present.

[a] Above Adams Lake.

[b] Downstream from Mabel Lake.

[c] Between Mable Lake and Shuswap Falls Dam.

[d] From Annual Narrative Reports (DFO, unpublished).

Appendix 15f. Annual chinook escapements to lower Thompson River and its tributaries, and to minor tributaries of the Fraser River, Hope to Lillooet, 1951-1980.

YEAR	BONA-PARTE R.	COLD-WATER R.	DEAD-MAN R.	NICOLA R.	SPIUS CR.	THOMP-SON R.	TOTAL THOMP-SON & TRIBS.	ANDER-SON R.	BRIDGE R.	GATES R.	NAHAT-LATCH R.	PORTAGE CR.	SETON R.[a]	STEIN R.	YALA-KOM R.	TOTAL HOPE-LILLOOET
1951	400	750	25	7500	400	750	9825	N/R	N/R	N/R	300	PRES	25	N/R	N/O	325
1952	25	1500	400	7500	1500	N/O	10925	N/R	N/R	N/R	200	100	25	N/R	25	350
1953	400	770	750	7100	1200	750	10970	N/R	N/R	N/R	75	PRES	25	N/R	25	125
1954	400	1500	400	7500	750	PRES	10550	N/R	N/R	N/R	PRES	25	25	N/R	N/O	50
1955	200	1500	750	7500	750	PRES	10700	N/R	N/R	N/R	400	25	25	N/R	PRES	450
1956	75	PRES	750	PRES	PRES	PRES	825	N/R	N/R	N/R	PRES	25	200	N/R	PRES	225
1957	25	400	25	3500	75	1500	5525	N/R	N/R	N/R	25	25	25	N/R	75	150
1958	75	200	750	7500	25	3500	12050	N/R	N/R	25	4	200	N/O	N/R	N/O	229
1959	200	200	750	7500	25	3500	12175	N/R	N/R	N/R	25	25	25	N/R	N/O	75
1960	N/O	200	750	3500	25	1500	5975	25	N/R	N/R	25	200	75	N/R	75	400
1961	N/O	200	200	400	N/O	750	1550	N/R	N/R	N/R	25	200	25	N/R	25	275
1962	75	200	750	3500	25	1500	6050	N/R	N/R	N/R	200	25	25	N/R	25	275
1963	25	200	750	3500	25	1500	6000	N/R	N/R	N/R	200	25	25	N/R	25	275
1964	25	160	200	4500	40	3500	8425	25	N/R	N/R	120	80	50	N/R	25	300
1965	N/O	200	200	3500	75	1500	5475	N/R	N/R	N/R	75	750	75	N/R	N/O	900
1966	N/O	100	25	500	20	750	1395	N/R	N/R	N/R	15	N/O	N/O	N/R	N/O	15
1967	25	200	N/O	2500	25	1500	4250	N/R	N/R	N/R	25	50	25	N/R	25	125
1968	15	250	20	3600	25	2000	5910	N/R	N/R	N/R	25	20	25	N/R	50	120
1969	20	250	20	4000	75	2500	6865	N/R	N/R	N/R	25	100	25	N/R	75	225
1970	20	750	25	3500	750	2500	7545	N/R	N/R	N/R	25	150	25	N/R	150	350
1971	20	350	25	2000	500	2500	5395	N/R	N/R	N/R	25	200	25	N/R	100	350
1972	10	100	10	1500	400	2000	4020	N/R	N/R	N/R	25	50	10	N/R	50	135
1973	150	1000	200	2800	500	2000	6650	N/R	N/R	N/R	50	50	50	N/R	200	350
1974	25	300	100	2100	500	2000	5025	N/R	N/R	N/R	50	25	25	N/R	200	300
1975	100	1500	250	4500	850	4000	11200	N/R	100	N/R	200	200	25	N/R	450	975
1976	30	500[b]	200[b]	3500[b]	200	2000	6430	N/R	300	N/R	50	70	30	N/R	50	500
1977	N/R	600	150[b]	2700	150	PRES[c]	3600	N/R	200	N/R	25	500	70	20	50	865
1978	50	750	280[b]	3100	80	PRES[c]	4260	N/R	500	N/R	50	250	150	N/R	170	1120
1979	N/R	300	50	2300	50	PRES[c]	2700	N/R	200	N/R	25	100	20	25	N/O	370
1980	75	710	250	5000	200	PRES[c]	6235	N/R	75	N/R	200	75	75	25	N/O	450
51-60	200	780	535	6567	528	1917	8952	25	N/R	25	132	78	50	N/R	50	238
61-70	29	251	243	2950	118	1800	5347	25	N/R	N/R	74	156	33	N/R	50	286
71-80	58	611	152	2950	343	2417	5552	N/R	229	N/R	70	152	48	23	159	542
76-80	52	572	186	3320	136	2000	4645	N/R	255	N/R	70	199	69	23	90	661

N/O=none observed; N/R=no record; PRES =present.

[a] Includes Cayoosh Cr.

[b] Estimate made by Field Services Branch, DFO.

[c] No estimate made due to poor observational conditions.

Appendix 15g. Annual chinook escapements to lower Fraser River tributaries, downstream from Hope, 1951-1980.

YEAR	BIG SILVER CR.	BIRK-ENHEAD R.	CHEHA-LIS R.	CHIL-LIWACK R.	COG-BURN CR.	DOUG-LAS CR.	HARRI-SON R.	LIL-LOOET R.	MARIA SLOUGH	MYST-ERY CR.	PITT R.	SLO-QUET R.	STAVE R.	TIPP-ELLA CR.	WEAVER CR.	TOTAL
1951	75	750	400	1500	N/R	N/R	1500	N/R	75	N/R	750	N/R	N/O	N/R	N/R	5050
1952	200	750	750	750	PRES	N/R	75000	N/R	200	25	1500	750	N/O	N/R	N/R	79925
1953	200	1500	75	400	N/R	N/R	15000	N/R	200	N/R	1500	200	N/O	N/R	N/R	19075
1954	75	750	750	750	25	25	15000	N/R	75	N/R	750	N/R	75	N/R	N/R	18275
1955	75	750	400	750	N/R	N/R	7500	N/R	25	N/R	750	N/R	200	N/R	N/R	10450
1956	300	750	N/O	750	N/R	N/R	3500	N/R	75	N/R	1500	N/R	PRES	N/R	N/R	6875
1957	200	3500	25	400	N/R	N/R	3500	N/R	200	N/R	1500	N/R	PRES	N/R	N/R	9325
1958	25	750	25	750	N/R	N/R	16500	N/R	25	N/R	3500	N/R	25	25	N/R	21625
1959	75	750	25	750	N/R	N/R	18000	N/R	25	N/R	750	PRES	25	N/R	N/R	20400
1960	300	750	25	400	N/R	N/R	3500	N/R	25	N/R	400	N/R	25	N/R	N/R	5425
1961	75	750	25	400	25	N/R	5000	N/R	25	N/R	400	PRES	25	N/R	N/R	6725
1962	50	750	200	400	N/R	N/R	2000	N/R	150	N/R	3500	N/R	25	N/R	25	7100
1963	24	750	25	400	N/R	N/R	13500	N/R	260	N/R	750	PRES	25	N/R	25	15759
1964	25	750	25	400	N/R	N/R	6000	N/R	PRES	N/R	1500	PRES	25	N/R	25	8750
1965	50	750	25	200	N/R	N/R	8500	N/R	150	N/R	400	PRES	25	N/R	N/R	10100
1966	25	750	25	75	25	N/R	9000	N/R	119	N/R	1500	N/R	25	N/R	N/R	11544
1967	25	100	25	25	25	25	7500	N/R	200	N/R	750	N/R	25	N/R	N/R	8700
1968	25	750	75	25	N/R	25	7500[a]	N/R	75	N/R	400	N/R	25	N/R	N/R	8900
1969	75	1000	N/O	300	N/R	25	7500	N/R	400	N/R	200	N/R	N/O	N/R	N/R	9500
1970	75	1500	N/O	200	N/R	25	7500	N/R	200	N/R	1500	N/R	N/O	N/R	N/R	11000
1971	75	250	25	25	N/R	25	15000	N/R	75	N/R	7500	PRES	N/O	N/R	N/R	22975
1972	200	400	75	200	N/R	25	15000	N/R	200	N/R	750	N/R	N/O	N/R	N/R	16850
1973	200	200	75	100	N/R	25	35000	N/R	200	N/R	750	N/R	N/O	N/R	N/R	36550
1974	200	400	25	100	N/R	25	35000	N/R	75	N/R	500	25	N/O	N/R	N/R	36350
1975	75	200	25	100	N/R	25	15000	400	75	N/R	300	25	N/O	N/R	N/R	16225
1976	25	200	25	25	N/R	25	7500	400	25	N/R	750	75	N/O	N/R	N/R	9050
1977	75	600	25	25	25	25	25000	400	200	N/R	700	PRES	N/O	N/R	N/R	27075
1978	25	400	25	100	25	25	15000	400	150[b]	N/R	150[b]	PRES	25	N/R	N/R	16325
1979	75	200	25	50	N/R	N/R	15000	750	75	N/R	250	PRES	N/R	N/R	N/R	16425
1980	20	300	25	50	N/R	N/R	10000	300	100	N/R	200	N/O	N/R	N/R	N/R	10995
51-60	153	1100	275	720	25	25	15900	N/R	93	25	1290	475	70	25	N/R	19643
61-70	45	785	53	243	25	25	7400	N/R	175	N/R	1090	N/R	25	N/R	25	9808
71-80	97	315	35	78	25	25	18750	442	118	N/R	1185	42	25	N/R	N/R	20882
76-80	44	340	25	50	25	25	14500	450	110	N/R	410	75	25	N/R	N/R	15974

N/O=none observed; N/R=no record; PRES.=present.

[a] Petersen tag experiment by Fisheries Headquarters staff gave escapement estimate of 34,000.

[b] Estimate made by Field Services Branch, DFO.

Appendix 16a. Annual coho escapements to North Thompson River and its tributaries, 1951-1980.

YEAR	AL-BREDA R.	AVOLA R.	BAR-RIERE R.	BLUE R.	BROOK FIELD CR.	CEDAR CR.	CLEAR-WATER R.	COOK CR.	DUNN CR.[a]	EAST BAR-RIERE R.	FEN-NEL CR.	FINN CR.	HAG-GARD CR.	LEM-IEUX CR.	LION CR.	LOUIS CR.	MCTAG-GART CR.	MAD R.	MA-HOOD R.	MANN CR.	NORTH THOMP-SON R.	RAFT R.	REG CRIS-TIE CR.	TUM TUM CR.	TOTAL
1951	N/R	N/R	400	N/R	N/R	N/R	PRES	N/R	400	N/R	N/R	200	N/R	75	400	400	N/R	25	N/R	N/R	N/R	200	N/R	N/R	2100
1952	N/R	N/R	PRES	N/R	N/R	N/R	PRES	N/R	PRES	N/R	N/R	PRES	N/R	1500	PRES	1500	N/R	75	N/R	400	N/R	3500	200	N/R	7175
1953	N/R	N/R	750	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	3500	N/R	3500	1500	1500	N/R	N/R	N/R	N/R	1500	750	200	N/R	13200
1954	N/R	N/R	200	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/D	N/R	1500	400	3500	N/R	N/R	N/R	N/R	1500	PRES	PRES	N/R	7100
1955	N/R	N/R	1500	N/R	N/R	N/R	3500	N/R	N/R	N/R	N/R	N/D	N/R	3500	200	7500	N/R	N/R	N/R	200	PRES	1500	75	N/R	17975
1956	N/R	N/R	750	N/R	N/R	N/R	PRES	N/R	N/R	N/R	N/R	N/D	N/R	750	N/D	750	N/R	N/R	N/R	N/D	PRES	200	200	N/R	2650
1957	N/R	N/R	25	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	750	200	750	N/R	N/R	N/R	N/D	PRES	1500	25	N/R	3250
1958	N/R	N/R	750	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	75	200	750	N/R	N/R	N/R	N/D	PRES	75	N/D	N/R	1850
1959	N/R	N/R	750	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	400	400	400	N/R	N/R	N/R	200	PRES	200	200	N/R	2550
1960	N/R	N/R	200	N/R	N/R	N/R	28	N/R	N/R	N/R	N/R	N/R	N/R	400	3500	1500	N/R	N/R	N/R	N/D	PRES	25	N/D	N/R	5653
1961	N/R	N/R	750	N/R	N/R	N/R	N/R	N/R	25	N/R	N/R	200	N/R	1500	7500	1500	N/R	N/R	N/R	200	PRES	750	N/D	N/R	12425
1962	N/R	N/R	750	N/R	N/R	N/R	N/R	N/R	N/D	N/R	N/R	200	N/R	750	7500	1500	N/R	N/R	N/R	75	PRES	75	N/D	N/R	10850
1963	N/R	N/R	75	N/R	N/R	N/R	N/R	N/R	N/D	N/R	N/D	200	N/R	200	1500	750	N/R	N/R	N/R	25	PRES	25	N/D	N/R	2775
1964	N/R	N/R	400	N/R	N/R	N/R	N/R	N/R	N/D	N/R	N/D	75	N/R	750	3500	200	N/R	N/R	N/R	25	PRES	1500	N/D	N/R	6450
1965	N/R	N/R	1500	N/R	N/R	N/R	N/R	N/R	750	N/R	750	1500	N/R	3500	1500	1500	N/R	N/R	N/R	400	750	1500	N/D	N/R	13650
1966	N/R	N/R	400	N/R	N/R	N/R	N/R	N/R	200	N/R	25	400	N/R	1500	750	750	N/R	N/R	N/R	200	PRES	750	200	N/R	5175
1967	N/R	N/R	200	N/R	N/R	N/R	N/R	N/R	200	N/R	N/D	200	N/R	750	500	400	N/R	N/R	N/R	N/D	PRES	200	N/D	N/R	2450
1968	N/R	N/R	400	N/R	75	N/R	N/R	N/R	75	N/R	200	400	N/R	750	1000	1500	N/R	N/R	N/R	75	PRES	750	75	25	5325
1969	N/R	N/R	750	N/R	25	N/R	N/R	N/R	200	N/R	200	400	N/R	1500	1500	1500	N/R	N/R	N/R	25	PRES	750	25	75	6950
1970	N/R	N/R	750	N/R	25	N/R	N/R	N/R	750	N/R	1500	200	N/R	1500	1500	1500	75	N/R	N/R	75	PRES	750	25	N/D	8650
1971	N/R	N/R	463	N/R	2	N/R	N/R	N/R	310	191	432	179	N/R	1500	1810	3327	32	N/R	N/R	143	PRES	750	17	42	9198
1972	N/R	N/R	400	N/R	25	N/R	N/R	N/R	367	75	750	25	N/R	400	650	2500	65	N/R	N/R	25	200	550	25	30	6087
1973	N/R	N/R	350	N/R	N/R	N/R	2000	N/R	500	65	120	50	N/R	725	2250	700	50[b]	N/R	PRES	90	PRES	450	30	65	7445
1974	6	N/R	620[b]	300	N/R	N/R	2000	N/R	390[b]	40[b]	290[b]	90[b]	N/R	850[b]	700[b]	4000[b]	2[b]	N/R	35	55[b]	2000	700[b]	N/D	6[b]	12084
1975	N/R	N/R	300[b]	250	N/R	N/R	400[b]	N/R	350[b]	60[b]	90[b]	15[b]	N/R	400[b]	600[b]	1200[b]	20[b]	N/R	25	8[b]	1500[b]	500[b]	N/D	6[b]	5724
1976	N/R	N/R	300	25	N/R	N/R	PRES	N/R	400	25	75	10[b]	N/R	200	550[b]	1100[b]	20[b]	N/R	PRES	25	PRES	350[b]	50	N/D	3130
1977	440	N/R	420	510	N/R	15	1500	N/R	530	18	380	6	N/R	650	650	2200	65[b]	N/R	10	60	1500	350	8[b]	10	9322
1978	180	5	400	600	N/R	15	400	60	700	110	300	100	N/R	600	2300	1300	80	N/R	12	20	300	250	20	10	7762
1979	200	N/D	400	600	N/R	175	400	60	400	120	600	15	30	200	250	1400	40	N/R	5	N/D	125	120	5	4	5149
1980	325	N/D	60	300	N/R	40	100	10	210	25	40	25	5	180	300	700	10	N/R	N/D	20	100	90	10	4	2554

Appendix 16a. (cont'd).

YEAR	AL-BREDA R.	AVOLA R.	BAR-RIERE R.	BLUE R.	BROOK FIELD CR.	CEDAR CR.	CLEAR-WATER R.	COOK CR.	DUNN CR.	EAST BAR-RIERE R.	FEN-NEL CR.	FINN CR.	HAG-GARD CR.	LEM-IEUX CR.	LION CR.	LOUIS CR.	MCTAG-GART CR.	MAD R.	MA-HOOD R.	MANN CR.	NORTH THOMP-SON R.	RAFT R.	REG CRIS-TIE CR.	TUM TUM CR.	TOTAL
51-60	N/R	N/R	592	N/R	N/R	N/R	1764	N/R	400	N/R	N/R	1850	N/R	1245	850	1855	N/R	50	N/R	267	1500	883	150	N/R	6350
61-70	N/R	N/R	598	N/R	42	N/R	N/R	N/R	314	N/R	535	378	N/R	1270	2675	1110	75	N/R	N/R	122	750	705	81	50	7470
71-80	230	5	371	369	14	61	971	43	416	73	308	52	18	571	1006	1843	38	N/R	17	50	818	411	21	20	6846
76-80	286	5	316	407	N/R	61	600	43	448	60	279	31	18	366	810	1340	43	N/R	9	31	506	232	19	7	5583

N/O=none observed; N/R=no record; PRES =present.

[a] Reported as Joseph Cr. before 1970.

[b] From Annual Narrative Reports (DFO, unpublished).

Appendix 16b. Annual coho escapements to South Thompson River and its tributaries, 1951-1980.

YEAR	ADAMS R.	UPPER ADAMS R.[a]	ANSTEY R.	BESSETTE CR.	BLURTON CR.	BOLEAU CR.	CANOE CR.	CREIGHTON CR.	DUTEAU CR.	EAGLE R.	HARRIS CR.	HUNAKWA CR.	IRELAND CR.	JOHNSON CR.	KINGFISHER CR.	MOMICH R.[b]	SALMON R.	SCOTCH CR.	SEYMOUR R.	LOWER SHUSWAP R.[c]	MID. SHUSWAP R.[d]	SINMAX CR.	S. PASS CR.	S. THOMPSON R.	TAPPEN CR.	TRINITY CR.	WAP CR.	TOTAL
1951	750	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	750	N/R	N/R	N/R	N/R	N/R	N/R	750	750	N/R	PRES	PRES	N/R	N/R	N/R	400	N/R	N/R	3400
1952	3500	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	7500	N/R	N/R	N/R	N/R	N/R	N/R	3500	N/R	N/R	N/R	N/R	N/R	N/R	N/R	400	N/R	N/R	14900
1953	3500	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	1500	N/R	N/R	N/R	N/R	N/R	N/R	400	200	N/R	3500	1500	N/R	N/R	N/R	400	N/R	N/R	11000
1954	750	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	3500	N/R	N/R	N/R	N/R	N/R	N/R	PRES	N/R	N/R	PRES	750	N/R	N/R	N/R	PRES	N/R	N/R	5000
1955	3500	3500	N/R	N/R	N/R	N/R	N/R	N/R	N/R	1500	N/R	N/R	N/R	N/R	N/R	N/R	7500	N/R	N/R	3500	3500	N/R	N/R	N/R	750	N/R	N/R	23750
1956	750	1000	N/R	N/R	N/R	N/R	N/R	N/R	N/R	3500	N/R	N/R	N/R	N/R	N/R	N/R	400	N/R	N/R	1500	750	N/R	N/R	N/R	300	N/R	N/R	8200
1957	750	750	N/R	N/R	N/R	N/R	N/R	N/R	N/R	3500	N/R	N/R	N/R	N/R	N/R	PRES	1500	N/R	N/R	750	400	75	N/R	N/R	25	N/R	N/R	7750
1958	400	3500	750	N/R	N/R	N/R	N/R	N/R	N/R	1500	N/R	N/R	N/R	N/R	N/R	400	3500	N/R	N/R	3500	1500	750	N/R	N/R	25	N/R	N/R	15825
1959	750	1500	N/D	N/R	N/R	N/R	N/R	N/R	N/R	1500	N/R	N/R	N/R	N/R	N/R	400	750	N/R	N/R	1500	750	750	N/R	N/R	200	N/R	N/R	8100
1960	1500	750	25	N/R	N/R	N/R	N/R	N/R	N/R	1500	N/R	N/R	N/R	N/R	N/R	400	1500	25	N/R	1500	3500	200	N/R	N/R	25	N/R	N/R	10925
1961	200	3500	750	N/R	N/R	N/R	N/R	N/R	N/R	3500	N/R	N/R	N/R	N/R	N/R	400	1500	N/R	N/R	750	3500	200	N/R	N/R	25	N/R	N/R	14325
1962	750	500	75	200	N/R	N/R	N/R	N/R	N/R	3500	N/R	N/R	N/R	N/R	N/R	750	750	N/R	N/R	750	1500	750	N/R	N/R	200	N/R	N/R	9725
1963	750	750	25	75	N/R	N/R	N/R	N/R	N/R	750	N/R	N/R	N/R	N/R	N/R	200	1500	N/R	N/R	750	1500	200	N/R	N/R	25	N/R	N/R	6525
1964	400	1500	75	1500	N/R	N/R	25[e]	N/R	N/R	1500	N/R	N/R	N/R	N/R	N/R	200	750	N/R	N/R	3500	750	75	N/R	N/R	25	N/R	N/R	10300
1965	750	N/D	25	2500	N/R	N/R	N/R	N/R	N/R	3500	N/R	75	N/R	N/R	N/R	N/D	3500	N/R	25	200	400	400	N/R	N/R	25	N/R	N/R	11400
1966	400	PRES	N/D	1150	N/R	N/R	25[e]	N/R	N/R	1500	N/R	25	N/R	N/R	N/R	N/D	400	PRES	N/R	400	400	200	N/R	N/R	N/D	N/R	N/R	4500
1967	200	N/D	25	25	N/R	N/R	N/R	N/R	N/R	750	N/R	N/R	N/R	N/R	N/R	N/D	200	25	N/R	200	200	75	N/R	N/R	N/D	N/R	N/R	1700
1968	400	N/D	25	1650	N/R	N/R	25	N/R	N/R	1500	N/R	25	N/R	N/R	N/R	75	1000	25	N/R	400	400	400	N/R	75	25	N/R	25	6050
1969	750	PRES	25	1750	N/R	N/R	N/D	N/R	N/R	750	N/R	75	N/R	N/R	N/R	200	1500	N/R	N/R	750	750	200	N/R	N/R	25	N/R	PRES	6775
1970	400	PRES	25	750	N/R	N/R	25	N/R	N/R	1500	N/R	25	N/R	N/R	N/R	N/D	750	200	N/R	400	400	200	N/R	N/R	25	N/R	400	5100
1971	300	PRES	N/D	750	N/R	N/R	25	N/R	N/R	1500	N/R	25	N/R	N/R	N/R	75	1500	25	N/R	75	400	213	N/R	N/R	25	N/R	25	4938
1972	200	200[f]	25	1850	N/R	N/R	25	N/R	N/R	1500	N/R	25	N/R	N/R	N/R	25	2000	25	N/R	300	400	104	N/R	N/R	25	N/R	200	6904
1973	300	PRES	25	5[f]	N/R	N/R	10[f]	50[f]	500[f]	1800[f]	200[f]	40[f]	N/R	N/R	10[f]	25	600[f]	10[f]	N/R	250[f]	500[f]	165	30[f]	N/R	4[f]	N/R	250[f]	4774
1974	150[f]	200	25	1300[f]	N/R	N/R	25	25[f]	500[f]	2200[f]	N/R[f]	100[f]	N/R	N/R	25	25	1800[f]	25	N/R	100	500	130[f]	N/R[f]	N/R	N/D	N/R	25	7155
1975	100	60[f]	25	150[f]	N/R	N/R	30[f]	25[f]	550[f]	1400[f]	100[f]	30[f]	N/R	N/R	30[f]	25	900[f]	30[f]	N/R	100	250[f]	60[f]	25[f]	N/R	25	N/R	175[f]	4090
1976	10	PRES	25	5[f]	25	50	10	40[f]	325[f]	1100	105[f]	25	N/R	N/R	10	N/D	900	5	1[f]	40	60	25	20	N/R	1	N/R	20	2802
1977	338	150	N/R	70[f]	40	N/R	N/D	2[f]	94[f]	2694	N/R[f]	N/D	N/R	N/R	62	20	1588	N/R	25	100	594	40	40	N/R	12	N/R	516	6385
1978	150	100[f]	75	N/R[f]	10	50	100	30[f]	400[f]	2000	150[f]	200	15[f]	4[f]	10	40	1500	N/R	N/R	300	350	55	50	N/R	2	4[f]	300	5895
1979	100	475	N/D	50	25	50	75	30	300	2500	150	75	45	N/R	25	150	2000	N/R	40	300	500	140	60	N/R	3	45	400	7538
1980	200	75	10	60	16	20	60	10	350	1500	60	42	32	N/R	N/R	N/D	1300	PRES	6	350	550	30	20	N/R	N/D	10	250	4951

Appendix 16b. (cont'd).

YEAR	ADAMS R.	UPPER ADAMS R.	ANS-TEY R.	BES-SETTE CR.	BLUR-TON CR.	BOL-EAU CR.	CANOE CR.	CREI-GHTON CR.	DUT-EAU CR.	EAGLE R.	HAR-RIS CR.	HUNA-KWA CR.	IRE-LAND CR.	JOHN-SON CR.	KING FIS-HER CR.	MOM-ICH R.	SAL-MON R.	SCOT-CH CR.	SEY-MOUR R.	LOWER SHUS-WAP R.	MID. SHUS-WAP R.	SIN-MAX CR.	S. PASS CR.	S. THOMP SON R.	TAP-PEN CR.	TRI-NITY CR.	WAP CR.	TOTAL
51-60	1615	1833	388	N/R	N/R	N/R	N/R	N/R	N/R	2625	N/R	N/R	N/R	N/R	N/R	400	2200	325	N/R	2250	1581	444	N/R	N/R	281	N/R	N/R	10885
61-70	500	1563	117	1067	N/R	N/R	25	N/R	N/R	1875	N/R	45	N/R	N/R	N/R	304	1185	83	25	810	980	270	N/R	75	47	N/R	213	7640
71-80	185	180	30	471	23	43	40	27	377	1819	128	62	31	4	25	48	1409	20	18	192	410	96	35	N/R	12	20	216	5543
76-80	160	200	37	46	23	43	61	22	294	1959	116	86	31	4	27	70	1458	5	18	218	411	58	38	N/R	5	20	297	5514

N/O=none observed; N/R=no record; PRES =present.

[a] Above Adams Lake.

[b] Includes Cayenne Cr.

[c] Downstream of Mabel L.

[d] Between Mabel L. and Shuswap Falls Dam.

[e] From 1968 spawning file.

[f] From Annual Narrative Reports (DFO, unpublished).

Appendix 16c. Annual coho escapements to lower Thompson River and its tributaries, 1951-1980.

YEAR	BONA-PARTE R.	COLD-WATER R.	DEAD-MAN R.	NICOLA R.	SPIUS CR.	THOMP-SON R.	TOTAL
1951	75	3500	PRES	N/R	1500	PRES	5075
1952	25	1500	3500	750	750	N/R	6525
1953	3500	PRES	200	N/R	PRES	200	3900
1954	1500	750	750	N/R	750	PRES	3750
1955	N/R	7500	3500	3500	3500	N/R	18000
1956	N/R	PRES	400	PRES	PRES	N/R	400
1957	N/R	750	200	750	25	N/R	1725
1958	N/R	PRES	1500	750	200	N/R	2450
1959	N/R	N/O	400	N/O	N/O	N/R	400
1960	N/R	400	1500	400	25	N/R	2325
1961	N/R	400	750	200	25	N/R	1375
1962	N/R	75	400	400	25	N/R	900
1963	N/R	75	750	400	25	N/R	1250
1964	N/R	N/O	75	50	N/O	N/R	125
1965	25	750	1500	3500	75	N/R	5850
1966	75	5000	400	2000	200	200	7875
1967	N/R	100	N/O	25	25	300	450
1968	N/R	1000	20	1000	50	300	2370
1969	50	5000	20	2500	75	200	7845
1970	25	750	50	1000	1500	250	3575
1971	20	500	50	750	800	200	2320
1972	15	250	25	200	400	150	1040
1973	10	1000	100	300	400	200	2010
1974	10	1000	50	500	500	250	2310
1975	10	200	25	250	250	150	885
1976	20	200	35	400	300	200	1155
1977	N/R	300	50	400	200	PRES[a]	950
1978	N/R	1500	100	350	400	PRES[a]	2350
1979	N/R	150	30	150	25	PRES[a]	355
1980	N/R	75	N/O	N/O	N/O	PRES[a]	75
51-60	1275	2400	1328	1230	964	200	4455
61-70	44	1461	441	1108	222	250	3162
71-80	14	518	52	367	364	192	1345
76-80	20	445	54	325	231	200	977

N/O=none observed; N/R=no record; PRES =present.

[a] No estimate made.

Appendix 16d. Annual coho escapements to miscellaneous tributaries of the Fraser River, Hope to Lillooet, 1951-1980.

YEAR	AMER-ICAN CR.[a]	ANDER-SON R.	BRIDGE R.	COQUI-HALLA R.	GATES R.	NAHAT-LATCH R.	SPUZ-ZUM CR.	KAW-KAWA CR.[b]	PORT-AGE CR.	SETON R.[c]	STEIN R.	YALA-KOM R.	YALE CR.	TOTAL
1951	N/O	N/R	N/R	75	25	500	N/R	200	N/R	N/R	N/R	N/R	N/R	800
1952	N/O	N/R	N/R	200	400	400	N/R	200	N/R	N/R	N/R	N/R	N/R	1200
1953	N/O	N/R	N/R	25	400	N/R	N/R	75	N/R	N/R	N/R	N/R	N/R	500
1954	N/O	N/R	N/R	200	25	PRES	N/R	75	N/R	N/R	N/R	N/R	N/R	300
1955	N/O	N/R	N/R	200	25	3500	N/R	200	N/R	N/O	N/R	N/R	N/R	3925
1956	N/O	N/R	N/R	25	400	PRES	N/R	25	N/R	N/O	N/R	N/R	N/R	450
1957	N/O	N/R	N/R	75	2	1500	25	75	25	25	N/R	N/R	N/R	1727
1958	25	N/R	N/R	200	25	N/R	25	75	25	N/O	N/R	N/R	25	400
1959	25	N/R	N/R	75	N/R	N/R	25	75	N/O	N/O	N/R	N/R	25	225
1960	25	N/R	N/R	200	N/R	N/O	25	25	2	N/R	N/R	N/R	25	302
1961	25	N/R	N/R	200	75	200	25	75	25	N/R	N/R	N/R	25	650
1962	25	N/R	N/R	200	400	15000[d]	25	75	25	N/R	N/R	N/R	25	15775
1963	25	25	N/R	25	75	25	25	25	25	25	N/R	N/R	25	300
1964	25	25	N/R	75	400	25	25	200	30	16	N/R	N/R	25	846
1965	25	N/R	N/R	200	750	1500	25	200	400	N/O	N/R	N/R	25	3125
1966	N/O	25	N/R	75	400	1000	25	200	25	N/R	N/R	N/R	N/R	1750
1967	N/O	N/R	N/R	25	200	100	25	200	25	5	N/R	N/R	N/R	580
1968	25	N/R	N/R	25	200	500	75	71	125	N/R	N/R	N/R	N/R	1021
1969	N/O	25	N/R	25	300	1000	N/O	750	100	N/R	N/R	N/R	N/R	2200
1970	N/O	N/R	N/R	25	750	750	50	2000	150	N/R	N/R	N/R	N/R	3725
1971	N/O	25	N/R	N/O	1500	750	N/O	200	100	N/R	N/R	N/R	N/R	2575
1972	N/O	N/R	N/R	25	750	450	N/O	450	100	15	N/R	N/R	N/R	1790
1973	N/O	N/R	N/R	50	400	500	50	1200	100	N/R	N/R	N/R	N/R	2300
1974	N/O	N/R	N/R	50	1500	100	25	75	50	N/R	N/R	N/R	N/R	1800
1975	N/O	N/R	100	50	1500	50	N/O	700	25	N/R	N/R	100	N/R	2525
1976	N/R	N/R	250	25	400	200	N/O	200	80	20	N/R	50	N/R	1225
1977	N/R	N/R	50	75	400	800	N/O	600[e]	500	30	N/R	40	N/R	2495
1978	N/O	N/R	1000	50	1500	300	N/O	400[e]	500	30	N/R	250	N/R	4030
1979	N/O	N/R	80	50	1500	25	N/O	50	N/R	70	25	N/O	N/R	1800
1980	N/O	N/O	25	N/O	2000	N/O	N/O	36	150	25	N/O	N/O	N/R	2236
51-60	25	N/R	N/R	128	163	1475	25	103	17	25	N/R	N/R	25	983
61-70	25	25	N/R	88	355	2010	33	380	93	15	N/R	N/R	25	2997
71-80	N/R	25	251	47	1145	353	38	391	178	32	25	110	N/R	2278
76-80	N/R	N/R	281	50	1160	331	N/O	257	308	35	25	113	N/R	2357

N/O=none observed; N/R=no record; PRES =present.

[a] Also known as Bar Cr.

[b] Also known as Sucker Cr.

[c] Includes Cayoosh Cr.

[d] Probably overestimated.

[e] Estimate made by Field Services Branch, DFO.

Appendix 16e. Annual coho escapements to Lillooet River and its tributaries, 1951-1980.

YEAR	BIRKENHEAD R.	GREEN R.	JOHN SANDY R.	LILLOOET R.[a]	MCKENZIE R.	MILLER CR.	PEMBERTON CR.	POOLE CR.	RAIL ROAD CR.	RYAN CR.	SALMON SLOUGH	TWENTY FIVE MILE CR.[b]	TOTAL
1951	7500	25	N/R	7500	N/O	25	25	750	N/R	75	25	N/R	15925
1952	15000	25	N/R	15000	400	200	25	750	N/R	3500	200	N/R	35100
1953	3500	25	N/R	1500	N/O	25	25	200	N/R	200	400	N/R	5875
1954	750	400	N/R	200	75	75	25	75	N/O	200	200	N/R	2000
1955	1500	200	N/R	25	25	25	25	200	N/O	200	75	N/R	2275
1956	3500	25	N/R	200	N/O	25	N/O	25	25	25	25	25	3875
1957	1500	25	N/R	200	25	25	N/O	50	25	25	200	N/R	2075
1958	2000[c]	75	25	75	25	25	25	75	25	200	75	25	2650
1959	2000[c]	75	N/R	75	N/O	25	25	25	25	200	200	N/R	2650
1960	3500	200	25	200	25	25	25	25	25	200	75	75	4400
1961	2500	750	N/O	75	25	PRES	25	75	25	400	75	75	4025
1962	2500	750	N/O	400	N/O	25	25	75	75	400	75	200	4525
1963	3500	400	N/O	750	N/O	N/O	25	75	25	400	75	75	5325
1964	3500	400	75	75	N/O	N/O	25	200	200	400	200	N/R	5075
1965	3500	400	75	75	25	25	25	200	200	400	200	200	5325
1966	3500	200	N/O	750	N/O	25	25	200	75	400	200	N/R	5375
1967	3000	500	50	300	N/O	50	50	200	100	250	200	N/R	4700
1968	3500	300	100	200	N/O	N/O	50	200	50	250	150	75	4875
1969	1200	600	N/O	800	N/O	50	50	470	270	900	900	N/R	5240
1970	3000	1500	N/R	1500	N/O	75	400	400	750	700	N/O	N/R	8325
1971	3500	2500	150	2500	N/O	150	200	700	1200	400	400	N/R	11700
1972	3500	400	75	750	N/O	75	25	200	200	200	200	N/R	5625
1973	1500	400	25	750	N/O	75	25	200	200	200	75	N/R	3450
1974	7500	400	25	750	N/O	25	25	200	750	400	75	25	10175
1975	3500	400	25	3500	N/O	75	25	400	400	200	1500	25	10050
1976	1500	400	N/O	400	N/O	25	25	75	75	75	1500	25	4100
1977	1500	PRES	25	3500	N/O	25	25	75	400	400	700	150	6800
1978	3500	PRES	25	3500	N/O	25	25	400	200	200	400	25	8300
1979	3500	PRES	25	1500	N/O	25	25	75	75	75	750	100	6150
1980	1500	PRES	PRES	6500	N/O	25	25	100	400	300	500	200	9550
51-60	4075	108	25	2498	96	48	25	218	25	483	148	42	7683
61-70	2970	580	75	493	25	42	70	210	177	450	231	125	5279
71-80	3100	750	47	2365	N/O	53	43	243	390	245	610	79	7590
76-80	2300	400	25	3080	N/O	25	25	145	230	210	770	100	6980

N/O=none observed; N/R=no record; PRES =present.

[a] Above Lillooet L.

[b] Also known as Sampson Cr.

[c] From 1961 and 1962 spawning files (DFO).

Appendix 16f. Annual coho escapements to Harrison River and its tributaries, 1951-1980.

YEAR	BIG SILVER CR.	CHEHALIS R.	COGBURN CR.	COHO CR.	DOUGLAS CR.	EAST CR.	HARRISON R.	MIAMI SLGH	MYSTERY CR.	PURCELL CR.	SAKWI CR.	SQUAKUM CR.	SLOQUET CR.	STEELHEAD CR.	STOKKE CR.	TIPELLA CR.	TROUT LAKE CR.[a]	TWENTY MILE CR.	WEAVER CR.	TOTAL
1951	200	3500	N/R	N/R	75	25	PRES	N/R	25[b]	75	N/R	25	N/R	N/R	25	N/R	25	25	750	4750
1952	PRES	7500	N/R	N/R	25	N/R	N/R	N/R	25	N/R	N/R	200	N/R	N/R	N/R	N/R	25	N/R	7500	15275
1953	25	15000	N/R	N/R	N/O	N/R	N/O	200	N/R	N/R	N/R	400	400	N/R	N/R	N/R	25	N/R	3500	19550
1954	PRES	7500	N/R	400	25	N/R	N/O	N/R	N/R	200	N/R	200	N/R	N/R	N/R	N/R	N/O	N/R	1500	9825
1955	75	3500	N/R	N/O	N/O	N/R	N/O	N/R	N/R	N/R	N/R	75	N/R	N/R	N/R	N/R	N/O	N/R	1500	5150
1956	300	2500	N/R	N/O	N/R	25	N/O	75	N/O	N/R	N/R	25	N/R	N/R	N/R	N/R	N/O	N/O	750	3675
1957	N/R	7500	N/R	400	N/R	N/R	N/O	75	N/O	N/R	N/R	400	N/R	N/R	N/R	PRES	N/R	N/O	750	9125
1958	PRES	3500	N/R	400	N/O	25	N/O	25	N/R	N/R	N/R	200	N/R	N/R	N/R	75	N/R	N/R	1500	5725
1959	PRES	3500	N/R	400	N/O	PRES	N/O	N/O	N/R	N/R	N/R	200	2000	N/R	N/R	200	N/O	N/R	750	7050
1960	PRES	7500	N/R	400	N/R	N/O	N/O	N/O	N/R	25	N/R	N/R	N/R	N/R	N/R	N/R	25	N/R	400	8350
1961	PRES	7500	N/R	500	N/R	N/R	N/O	25	25	N/R	N/R	200	N/R	N/R	N/R	PRES	N/R	N/R	2100	10350
1962	PRES	15000	N/R	400	N/R	PRES	N/O	200	N/R	N/R	N/R	400	N/R	N/R	N/R	N/R	PRES	N/O	1500	17500
1963	PRES	3500	N/R	400	N/R	N/R	N/O	75	N/O	N/R	N/R	200	N/R	N/R	N/R	PRES	N/O	N/R	400	4575
1964	PRES	8000	N/R	350	N/R	N/O	200	75	N/O	N/R	N/R	400	N/R	N/R	N/R	PRES	25	N/R	1000	10050
1965	PRES	7500	N/R	250	N/R	25	N/R	25	N/R	6	N/R	200	N/R	N/R	N/R	75	25	N/R	1620[c]	9726
1966	PRES	15000	25	600	N/R	25	N/R	25	N/R	N/R	N/R	750	N/R	N/R	N/R	N/R	25	N/R	1580[c]	18030
1967	75	7500	25	200	25	N/O	75	N/O	N/O	N/R	N/R	400	N/R	N/R	N/R	N/R	N/O	N/O	750	9050
1968	200	3500	N/R	200	25	N/O	1500	N/O	N/R	N/R	N/R	200	N/R	N/R	N/R	N/O	N/O	25	750	6400
1969	200	3500	N/R	400	N/R	N/O	1500	25	25	25	N/R	400	N/R	N/R	N/R	25	25	25	750	6900
1970	200	7500	N/R	750	N/R	N/R	1500	N/O	25	25	N/R	75	N/R	N/R	N/R	N/R	25	N/R	1500	11600
1971	200	7500	N/R	750	25	25	3500	N/O	25	N/R	N/R	200	N/R	N/R	N/R	N/R	200	N/O	3500	15925
1972	75	1500	N/R	400	25	N/O	1500	N/O	N/O	N/R	N/R	75	N/R	N/R	N/R	N/O	25	N/O	400	4000
1973	75	1500	N/R	400	25	N/R	1500	N/O	75	N/R	N/R	400	N/R	N/R	N/R	25	25	25	3500	7550
1974	200	1500	N/R	400	25	N/O	1500	N/O	25	N/R	N/R	200	25	N/R	N/R	25	25	25	3500	7450
1975	75	750	N/R	1500	N/O	N/O	1500	N/O	25	N/R	N/R	200	25	N/R	N/R	25	75	25	7500	11700
1976	200	750	N/R	750	25	N/R	750	N/O	25	N/R	N/R	200	75	N/R	N/R	N/R	25	N/R	750	3550
1977	200[d]	1500	25	1500[d]	25	25	2500	N/O	25	N/R	N/R	150	N/R	N/R	N/R	N/O	25	25	3000	9000
1978	200[d]	1500	25	1500	25	N/O	1500	25	25	N/R	N/R	200	N/R	25	N/R	N/O	25	25	750	5825
1979	75	3500	N/O	750	25	N/O	750	N/O	N/O	N/R	25	200	N/R	750	N/R	N/O	25	N/O	750	6850
1980	100	800	25	600	25	N/O	1500	N/O	PRES	N/O	50	125	PRES	500	N/O	N/R	30	N/O	1500	5255
51-60	150	6150	N/R	400	42	25	N/R	94	25	100	N/R	192	1200	N/R	25	138	25	25	1890	8848
61-70	169	7850	25	405	25	25	955	64	25	19	N/R	323	N/R	N/R	N/R	50	25	25	1195	10418
71-80	140	2080	25	855	25	25	1650	25	32	N/R	38	195	42	425	N/R	25	48	25	2515	7711
76-80	155	1610	25	1020	25	25	1400	25	25	N/R	38	175	75	425	N/R	N/R	26	25	1350	6096

N/O=none observed; N/R=no record; PRES =present.

[a] Also known as Hatchery Cr.

[b] From a 1953 memo (File 31-1-H9).

[c] Includes separate report filed for Weaver Cr. spawning channel.

[d] Estimate made by Field Services Branch (DFO).

Appendix 16g. Annual coho escapements to minor tributaries of the Fraser River, Hope to Mission, north side, 1951-1980.

YEAR	BOU-CHIER CR.	CHIL-QUA SLGH.[a]	DRA-PER CR.	HAW-KINS CR.	HICKS CR.	IN-CHES CR.	LAG-ACE CR.	MA-HOOD CR.[b]	MARIA SLGH.	MOUN-TAIN SLGH.	NICO-MEN SLGH.[c]	NOR-RISH CR.[d]	PYE CR.	RUBY CR.	SID-DLE CR.[e]	SCO-REY CR.[f]	WILK-INSON CR.	WORTHS CR.	TOTAL
1951	25	75	N/R	75	750	75	N/R	N/R	75	N/R	750	N/R	N/R	N/R	75	25	25	25	1975
1952	25	200	N/R	25	750	25	PRES	N/R	200	N/R	200	1500	N/R	N/R	25	200	75	25	3250
1953	25	25	N/R	75	3500	25	25	N/R	750	N/R	400	400	200	N/R	200	25	25	25	5700
1954	75	25	N/R	75	1500	200	25	N/R	400	N/R	750	3500	N/R	N/R	200	75	75	25	6925
1955	25	25	N/R	25	1500	N/O	N/O	N/R	200	N/R	400	400	N/R	N/R	25	25	25	25	2675
1956	25	25[g]	N/R	25	1500	25	N/O	N/R	400	N/R	75	75	N/R	N/R	25	N/O	25	75	2275
1957	75	25	N/R	25	1500	25	25	N/R	400	N/R	1500	200	200	N/R	200	25	75	25	4300
1958	25	25	N/R	25	400	200	25	75	200	N/R	400	400	25	N/R	25	25	25	25	1900
1959	25	25	N/R	25	1500	75	PRES	75	400	N/R	400	400	25	N/R	25	25	25	25	3050
1960	25	25	N/R	25	500	75	N/O	N/R	200	N/R	200	400	25	PRES	25	25	25	25	1575
1961	25	25	N/R	25	750	75	N/O	75	200	N/R	400	300	25	PRES	75	25	25	200	2225
1962	25	25	N/R	75	2000	400	N/O	N/O	400	N/R	750	400	200	N/O	400	N/O	25	25	4725
1963	25[g]	25	N/R	25	700	200	N/O	N/O	200	N/R	400	200	25	PRES	75	N/O	25	25	1925
1964	PRES	75	N/R	200	2200	200	N/O	N/O	200	N/R	750	750	200	25	400	25	75	300	5400
1965	25	25	N/R	25	800	430	N/O	N/O	200	N/R	750	200	75	25	75	N/O	25	80	2735
1966	25	25	N/R	125	2200	500	N/O	6	200	N/R	750	200	200	25	200	N/O	N/R	400	4856
1967	25	25	N/R	400	1500	750	N/O	25	75	N/R	200	400	75	25	200	N/O	N/O	75	3775
1968	25	75	N/R	400	750	200	N/O	75	200	N/R	200	400	75	25	750	N/O	N/O	25	3200
1969	25	75	N/R	75	1500	200	N/O	75	400	N/R	200	400	25	25	750	N/O	N/O	25	3775
1970	25	75	N/R	25	750	25	25	25	200	N/R	200	200	200	25	750	N/O	N/O	25	2550
1971	25	75	N/R	25	1500	200	25	200	200	N/R	400	1500	200	200	400	25	25	200	5200
1972	25	75	N/R	N/O	75	25	N/O	25	200	N/R	75	200	25	25	200	N/R	N/O	N/O	950
1973	25	25	N/R	N/O	400	25	25	200	200	N/R	400	400	75	25	400	25	N/O	N/O	2225
1974	25	25	N/R	N/O	750	200	25[h]	200	200	N/R	400	400	75	25	750	25	N/O	N/O	3100
1975	25	75	N/R	N/O	1500	75	400	25	200	N/R	400	400	25	25	750	25	N/O	N/O	3925
1976	25	25	N/R	N/O	750	200	25	25	75	N/R	200	200	25	25	750	N/O	N/O	N/O	2325
1977	25	25[i]	N/R	N/O	600[i]	250	25[i]	50	200	N/R	825[i]	150[i]	200[i]	25	1500[i]	N/O	N/O	25	3900
1978	25	25[i]	N/R	N/O	950[i]	N/O	25[i]	25	200	200	425[i]	400[i]	75[i]	25	400[i]	N/O	N/O	25	2800
1979	25	25	25	N/O	750	75	25	25	75	N/O	750	200	200	25	400	N/O	N/O	25	2625
1980	25	100	25	N/O	500	75	50	25	250	30	800	750	150	50	800	25	25	50	3730
51-60	35	48	N/R	40	1340	81	25	75	323	N/R	508	808	95	N/R	83	50	40	30	3363
61-70	25	45	N/R	138	1315	298	25	47	228	N/R	460	345	110	25	368	25	35	118	3517
71-80	25	48	25	25	778	125	69	80	180	115	468	460	105	45	635	25	25	65	3078
76-80	25	40	25	N/O	710	150	30	30	160	115	600	340	130	30	770	25	25	31	3076

N/O=none observed; N/R=no record; PRES =present.

[a] Also known as Thompson Cr.

[b] Also known as Gallagher Cr.

[c] Includes escapements to Barnes and DeRoche Crs. (tribs. to Nicomen Slough).

[d] Also known as Suicide Cr.

[e] Also known as Bell's and Thathams Cr.

[f] Also known as Rouleau Cr.

[g] From brood year estimate in spawning file (DFO).

[h] Records obtained from District Office.

[i] Estimate made by Field Services Branch (DFO).

Appendix 16h. Annual coho escapements to Chilliwack River and its tributaries, 1951-1980.

YEAR	BARRETT CR.	BORDEN CR.	CHILLIWACK R.[a]	DEPOT CR.	DOLLY VARDEN CR.[b]	FIFTEEN MILE CR.	FOLEY CR.[c]	FOURTEEN MILE CR.	GUNTHER DITCH	HOPEDALE CR.	HOPEDALE SLGH.	LIUMCHEN CR.	LONZO CR.[d]	NESAKWATCH CR.[e]	PALEFACE CR.	POST CR.	RYDER CR.	SALWEIN CR.	SLESSE CR.	STEWART SLGH.	STREET CR.	SUMAS R.	SWELTZER CR.	TAMIHI CR.	TOTAL
1951	N/R	75	16500	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	75	N/R	200	400	N/R	17250
1952	N/R	75	18500	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	75	N/R	N/D	N/R	75	400	N/R	19125
1953	N/R	400	15750	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	25	N/R	25	N/R	75	750	N/R	17025
1954	N/R	200	9000	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	25	200	75	N/R	200	400	N/R	10100
1955	N/R	75	16500	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	75	200	25	N/R	75	96	N/R	17046
1956	N/R	25	15400	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	25	N/R	N/R	N/R	N/R	25	75	25	N/R	75	200	N/R	15850
1957	N/R	200	15200	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	25	N/R	N/R	N/R	N/R	25	750	25	N/R	200	75	N/R	16500
1958	N/R	75	35750	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	25	N/R	N/R	N/R	N/R	75	200	25	N/R	75	25	N/R	36250
1959	N/R	75	15400	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	25	N/R	N/R	N/R	N/R	75	400	25	N/R	200	400	N/R	16600
1960	N/R	200	7700	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/D	N/R	N/R	N/R	N/R	25	750	25	N/R	200	75	N/R	8975
1961	N/R	200	15400	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	25	N/R	N/R	N/R	N/R	75	400	25	N/R	200	25	N/R	16350
1962	N/R	75	76500[f]	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	25	N/R	N/R	N/R	N/R	75	200	25	N/R	400	200	N/R	77500
1963	N/R	75	75750[f]	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	25	N/R	N/R	N/R	N/R	25	200	25	N/R	75	75	N/R	76250
1964	N/R	25	35750	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	25	N/R	N/R	N/R	N/R	75	75	25	N/R	200	75	N/R	36250
1965	N/R	25	7900	25	1500	N/R	200	N/R	N/R	N/R	N/R	N/R	25	200	75	N/R	75	200	N/D	N/R	N/R	200	75	N/R	10500
1966	N/R	25	15400	25	1500	N/R	200	N/R	N/R	N/R	N/R	N/R	25	200	25	N/R	75	200	75	N/R	N/R	75	75	N/R	17900
1967	N/R	76	5000	25	200	N/R	25	N/R	N/R	N/R	N/R	N/R	25	125	25	N/R	75	75	75	N/R	N/R	25	188	N/R	5939
1968	N/R	110	7000	25	75	N/R	25	N/R	N/R	N/R	N/R	N/R	25	200	25	N/R	80	120	N/D	N/R	20	200	160	N/R	8065
1969	N/R	200	7000	25	2020	N/R	75	N/R	N/R	N/R	N/R	N/R	25	174	N/D	N/R	250	100	N/D	N/R	25	25[g]	150	N/R	10069
1970	N/R	75	7000	25	3000	N/R	25	N/R	N/R	N/R	N/R	N/R	25	200	25	N/R	200	75	75	N/R	N/D	25[g]	200	N/R	10950
1971	N/R	75	6000	N/D	2000	N/R	25	N/R	N/R	N/R	N/R	N/R	25	200	N/D	N/R	200	200	75	N/R	N/D	N/R	200	N/R	9000
1972	50	75	4000	25	250	N/R	50	N/R	N/R	N/R	N/R	N/R	25	75	N/D	N/R	200	100	75	N/R	30	75[g]	50	N/R	5080
1973	50	300	10000	N/D	2000	N/R	50	N/R	N/R	N/R	N/R	N/R	25	50	N/D	N/R	350	900	100	N/R	225	200	250	N/R	14500
1974	20	125	9500	N/D	1000	N/R	50	N/R	N/R	N/R	N/R	N/R	25	75	N/D	N/R	600	500	25	N/R	200	200	500	N/R	12820
1975	20	100	8000	N/D	400	N/R	100	N/R	N/R	N/R	N/R	N/R	20	20	N/D	N/R	300	100	100	N/R	20	200	75	N/R	9455
1976	150[h]	25[h]	3000[i]	25[h]	3000[j]	50[h]	75[h]	N/R	N/R	300[h]	N/R	25[h]	25	75[h]	25[h]	150[h]	150[h]	527[k]	150[h]	N/R	25[h]	100	150[f]	25[h]	8052
1977	225[h]	150[h]	6000[i]	20[h]	5000[j]	200[h]	20[h]	50[h]	20[h]	700[h]	75[h]	25[h]	25	75[h]	75[h]	350[h]	200[h]	649[k]	25[h]	N/R	225[h]	400	250[f]	25[h]	14784[m]
1978	150[h]	150[h]	5000[i]	25[h]	3000[j]	150[h]	175[h]	200[h]	10[h]	130[h]	25[h]	50[h]	25	150[h]	25[h]	150[h]	312[h]	724[k]	500[h]	N/R	50[h]	50	250[f]	50[h]	11351
1979	60	50	9000	20	3300	65	30	60	16	210	N/R	N/R	6	100	11	150	75	400	150	N/R	20	200	50	N/R	13973
1980	N/D	44	3000	N/D	1500	30	20	20	6	110	N/R	N/R	N/D	N/D	10	70	14	50	30	N/R	4	150	37	N/R	5095

Appendix 16h. (cont'd).

YEAR	BARRETT CR.	BORDEN CR.	CHILLIWACK R.	DEPOT CR.	DOLLY VARDEN CR.	FIFTEEN MILE CR.	FOLEY CR.	FOURTEEN MILE CR.	GUNTHER DITCH	HOPEDALE CR.	HOPEDALE SLGH.	LIUMCHEN CR.	LONZO CR.	NESAKWATCH CR.	PALEFACE CR.	POST CR.	RYDER CR.	SALWEIN CR.	SLESSE CR.	STEWART SLGH.	STREET CR.	SUMAS R.	SWELTZER CR.	TAMIHI CR.	TOTAL
51-60	N/R	140	16570	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	25	N/R	N/R	N/R	N/R	47	368	36	N/R	138	282	N/R	17472
61-70	N/R	89	25270	25	1383	N/R	92	N/R	N/R	N/R	N/R	N/R	25	183	35	N/R	126	102	157	25	23	143	122	N/R	26977
71-80	91	109	6350	23	2145	99	60	83	13	290	50	33	22	91	29	174	240	415	123	N/R	89	175	181	33	10411
76-80	146	84	5200	23	3160	99	64	83	13	290	50	33	20	100	29	174	150	470	171	N/R	65	180	147	33	10651

N/O=none observed; N/R=no record; PRES =present.

[a] Also known as Vedder-Chilliwack R.; includes spawning in mainstem, side channels, sloughs and unlisted creeks.

[b] Mainstem above Chilliwack L.

[c] Also known as Ford Cr.

[d] Also known as Marshall Cr.

[e] Also known as Middle Cr.

[f] Probably overestimated.

[g] Records obtained from District Office.

[h] Estimate made by Field Services Branch (DFO).

[i] Residual escapement left after subtracting revised Dolly Varden Cr. escapement.

[j] Dolly Varden Cr. estimates based on results from 1979 fence enumeration.

[k] Fence enumeration.

[l] Includes Frosst Cr.; estimated by Field Services Branch (DFO).

[m] Total spawning for Chilliwack system (excluding Sumas R. and Lonzo Cr.), estimated by Petersen tag, mark-recapture experiment (DFO, unpublished).

Appendix 16i. Annual coho escapements to minor tributaries of the Fraser River, Mission to mouth, north side, 1951-1980.

YEAR	BLANEY CR.	BRUNNETTE R.	CEDAR CR.	COQUITLAM R.	HOY CR.	HYDE CR.	KANAKA CR.	MCINTYRE CR.	MUSQUEAM CR.	N. ALOUETTE R.	PITT R.[a]	SILVERDALE CR.	S. ALOUETTE R.	STAVE R.	WIDGEON CR.[b]	WHONNOCK CR.	TOTAL[c]
1951	200	1500	N/R	750	N/R	N/R	400	200	N/R	400	400	400	750	200	1500	200	6900
1952	200	1500	N/R	750	N/R	N/R	400	200	N/R	750	7500	750	1500	1500	1500	750	17300
1953	200	1500	N/R	1500	N/R	N/R	400	200	N/R	750	3500	200	750	75	1150	400	10625
1954	200	3500	N/R	200	N/R	N/R	75	75	N/R	200	400	200	200	75	750	200	6075
1955	75	75	N/R	750	N/R	N/R	200	75	N/R	400	3500	200	750	200	400	200	6825
1956	25	200	N/R	200	N/R	N/R	200	25	N/R	200	400	25	400	25	200	25	1925
1957	75	750	N/R	200	N/R	N/R	200	25	N/R	200	1500	200	400	400	400	200	4550
1958	25	75	N/R	400	N/R	N/R	200	25	N/R	200	3500	75	400	75	400	25	5400
1959	25	25	N/R	75	N/R	N/R	25	25	N/R	25	400	200	25	75	25	200	1125
1960	75	75	N/R	200	N/R	N/R	75	25	N/R	200	400	25	200	25	200	200	1700
1961	25	75	N/R	25	N/R	N/R	25	25	N/R	25	3500	75	25	25	200	75	4100
1962	75	75	N/R	75	N/R	N/R	25	25	N/R	200	7500	200	75	25	1500	100	9875
1963	25	25	N/R	75	N/R	N/R	25	25	N/R	200	400	200	75	25	400	200	1675
1964	200	75	N/R	200	N/R	N/R	200	200	N/R	400	7500	200	75	200	750	200	10200
1965	75	N/O	N/R	75	N/R	N/R	75	75	N/R	75	1500	200	75	200	750	200	3300
1966	75	N/O	N/R	200	N/R	N/R	75	75	N/R	200	3500	200	200	200	750	200	5675
1967	25	N/O	N/R	200	N/R	N/R	75	75	N/R	200	1500	200	75	400	200	200	3150
1968	25	N/R	N/R	75	N/R	N/R	25	75	N/R	25	750	75	75	400	400	400	2325
1969	25	N/R	N/R	25	N/R	N/R	25	25	N/R	25	750	200	25	400	400	400	2300
1970	200	N/R	N/R	750	N/R	N/R	400	200	N/R	750	1500	400	750	400	750	750	6850
1971	200	N/R	N/R	750	N/R	N/R	400	200	N/R	750	35000[c]	400	750	400	1500	200	40550
1972	200	N/R	N/R	400	N/R	N/R	400	75	N/R	400	1500	75	400	200	400	200	4250
1973	75	N/R	N/R	750	N/R	N/R	400	75	N/R	750	3500	400	750	750	400	400	8250
1974	150	N/R	N/R	300	N/R	N/R	500	50	N/R	350	3500	400	750	750	250	200	7200
1975	100	N/R	N/R	600	N/R	N/R	100	75	N/R	600	3000	200	700	200	400	200	6175
1976	25	N/R	N/R	400	N/R	N/R	200	25	N/R	25	3500	25	400	75	400	200	5275
1977	30	N/R	N/R	450	N/R	N/R	50[d]	400[d]	25	375[e]	7500[d]	200[d]	375[e]	400	1500[d]	250[d]	11555
1978	60	N/R	N/R	25	N/R	N/R	100[d]	375[d]	1	250[e]	17500[d]	300[d]	250[e]	200	900[d]	350[d]	20311
1979	30	N/R	N/R	300	N/R	N/R	200	50	2	50	5000	200	400	75	400	200	6907
1980	100	N/R	25	400	12	25	200	50	2	300	2500	200	400	300	350	500	5364
51-60	110	920	N/R	503	N/R	N/R	218	88	N/R	333	2150	228	538	265	653	240	6243
61-70	75	63	N/R	170	N/R	N/R	95	80	N/R	210	2840	195	145	228	610	273	4945
71-80	97	N/R	25	438	12	25	255	138	8	385	8250	240	518	335	650	270	11584
76-80	49	N/R	25	315	12	25	150	180	8	200	7200	185	365	210	710	300	9882

N/O=none observed; N/R=no record; PRES =present.

[a] Above Pitt L.

[b] Also known as Silver Cr.; includes Widgeon Slough.

[c] Probably overestimated.

[d] Estimate made by Field Services Branch (DFO).

[e] Field Services Branch estimate does not differentiate between N. and S. Alouette R.; total estimate is halved for each branch arbitarily.

Appendix 16j. Annual coho escapements to minor tributaries of the Fraser River, Hope to mouth, south side, 1951-1980.

YEAR	ATCHE-LITZ CR.	CLAY-BURN CR.[a]	DUN-VILLE CR.	ELK CR.	HOPE SLGH.	HUN-TER CR.	LOREN-ZETTA CR.	LUCK-AKUCK CR.	NATHAN CR.[b]	POP-KUM CR.	SAL-MON R.	SIL-VER HOPE CR.[c]	WAH-LEACH CR.[d]	WAH-LEACH SLGH.	WEST CR.	YORK-SON CR.[e]	TOTAL
1951	N/O	200	200	25	N/R	25	200	200	200	25	400	200	25	N/R	400	75	2175
1952	200	200	75	750	N/R	25	750	200	1500	75	3500	75	75	N/R	1500	400	9325
1953	25	75	25	25	N/R	25	75	75	3500	25	3500	200	N/O	N/R	400	200	8150
1954	N/O	75	200	200	N/R	25	200	75	200	200	400	200	25	N/R	400	400	2600
1955	75	75	75	200	N/R	25	200	200	400	75	200	75	25	N/R	200	75	1900
1956	25	75	75	75	N/R	25	75	75	200	25	200	75	25	N/R	75	75	1100
1957	25	75	200	75	N/R	25	200	75	200	75	200	200	25	N/R	75	75	1525
1958	75	75	75	200	N/R	25	200	75	400	25	200	25	75	N/R	200	75	1725
1959	25	75	200	200	25	25	200	200	750	75	75	75	25	N/R	25	200	2175
1960	25	75	200	200	75	25	200	75	200	75	200	200	75	N/R	75	25	1725
1961	75	75	200	200	75	25	200	75	200	25	200	75	75	N/R	25	25	1550
1962	25	75	200	75	75	25	400	200	75	75	75	75	75	N/R	25	25	1500
1963	25	200	200	200	75	25	75	75	75	25	75	75	75	N/R	75	75	1350
1964	N/O	200	200	200	75	25	200	75	200	25	200	75	75	N/R	75	75	1700
1965	25	200	75	400	75	25	200	25	75	N/R	200	25	75	N/R	25	75	1500
1966	25	75	75	900	75	N/O	75	75	200	N/R	200	25	75	N/R	75	75	1950
1967	20	105	73	250	25	N/O	100	113	75	N/R	200	25	25	N/R	75	25	1111
1968	10	232	300	400	N/R	N/O	60	25	25	N/R	200	75	30	N/R	25	25	1407
1969	25	200	200	200	PRES	N/O	300	25	25	N/R	75	25	65	25	25	25	1215
1970	25	200	200	1000	75[f]	N/O	800	25	200	N/R	1500	25	150	25	200	400	4825
1971	25	200	1000	900	25	N/O	200	N/O	400	N/R	3500	75	25	N/R	400	400	7150
1972	20	500	50	300	25	N/O	150	75	750	N/R	1500	75	50	N/R	200	200	3895
1973	25	650	200	400	PRES	N/O	200	50	750	N/R	750	50	125	N/R	750	400	4350
1974	25	600	130	550	PRES	N/O	200	250	1200	N/R	3500	25	100	N/R	850	650	8080
1975	25	200	50	100	50	N/O	200	50	1000	N/R	3600	25	20	N/R	1200	600	7120
1976	25	25	25	25	25	N/O	25	25	1500	N/R	3500	N/O	N/O	N/R	400	750	6325
1977	25	600[g]	450[g]	600[g]	25	N/O	75[g]	100[g]	700[g]	N/R	3500[g]	25[g]	N/O	N/R	300[g]	150[g]	6550
1978	N/O	800[g]	300[g]	650[g]	25	N/O	150[g]	250[g]	1100[g]	N/R	5500[g]	25[g]	N/O	N/R	200[g]	75[g]	9075
1979	N/O	N/O	25	54	25	N/O	50	20	1200	N/R	3500	N/R	N/O	N/R	100	150	5124
1980	N/O	38	140	350	25	N/O	188	92	375	N/R	1500	N/R	30	N/R	150	200	3088
51-60	59	100	133	195	50	25	230	125	755	68	888	133	42	N/R	335	160	3240
61-70	28	156	172	383	69	25	241	71	115	38	293	50	72	25	63	83	1811
71-80	24	401	237	393	28	N/O	144	101	898	N/R	3035	43	58	N/R	455	358	6076
76-80	25	366	188	336	25	N/O	98	97	975	N/R	3500	25	30	N/R	230	265	6032

N/O=none observed; N/R=no record; PRES =present.

[a] Also known as Kelly Cr; includes Stoney Cr.

[b] Also known as Beaver Cr.

[c] Also known as Silver Cr.

[d] Also known as Jones Cr.

[e] Also known as Jenkins Cr.

[f] Records obtained from District Office.

[g] Estimate made by Field Services Branch (DFO).

Appendix 17. Annual commercial catches of chinook and coho in various fishing areas where Fraser River stocks are suspected to be vulnerable.[a]

	CHINOOK			COHO	
	NORTHERN TROLL (AREAS 1 TO 11 &30) &30)	GEORGIA STRAIT TROLL (AREAS 12 TO 20, 28&29)	PUGET SOUND NET (INTERCEP. FISHERIES ONLY)	WEST CST OF VANC I. TROLL (AREAS 21 TO 27 & C)	GEORGIA STRAIT TROLL (AREAS 12 TO 20, 28&29)
1951	112017	65901	27992	924926	591444
1952	148933	96037	25917	861604	590297
1953	148259	126844	30824	683972	509688
1954	86408	97616	26134	555573	381011
1955	74328	77911	27447	530358	514345
1956	87084	108139	22787	647720	271200
1957	81239	143264	23872	661808	410983
1958	108894	204944	21915	823755	439854
1959	119499	157634	29338	919446	334094
1960	106697	109250	23723	369606	528890
1961	100089	123981	21890	1095914	371140
1962	97226	129746	13441	1072345	351965
1963	118798	142809	32327	1081544	212627
1964	191253	109250	26913	1210555	388474
1965	171278	104576	32544	1705331	317408
1966	211585	128709	42180	1429956	558355
1967	203566	147332	50405	1168312	240203
1968	225031	107277	34633	1952130	262660
1969	232247	120823	39959	1106401	103391
1970	270931	157819	69168	1364816	313192
1971	275404	303854	86329	2353193	327318
1972	356143	246410	49590	1133722	122339
1973	271169	157209	58526	1598405	123197
1974	314364	190108	58199	1826824	211282
1975	327924	196246	99648	886429	141010
1976	317302	230382	72904	1852952	172882
1977	242325	279183	99255	1620431	197604
1978	233249	229154	98921	1360952	374250
1979	244803	271186	66954	1913030	256974
1980	242950	279845	81193	1705823	178888
1951-55	119963	92862	27663	711287	517357
1956-60	114153	144646	24327	684467	397004
1961-65	145937	122072	25423	1233138	328323
1966-70	247100	132392	47269	1404323	295560
1971-75	309001	218765	70458	1559715	185029
1976-80	256126	257950	83845	1690638	236120
1951-80	198713	161448	46498	1213928	326566

[a] All Canadian catches were summarized from Annual Reports published by DFO; Puget Sound net catches were totalled from known interception areas, including outer Juan de Fuca Strait, West Beach, the San Juan Islands, and Point Roberts – catches were taken from Annual Reports published by Washington Dept. Fish and Game (except for pre-1960 catches which were estimated by subtracting the total Puget Sound terminal catches from the total Puget Sound net catches as published in the 1962 Annual Report of the Washington Dept. Fish and Game).