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Stock Assessment of Thompson River/Upper Fraser River Coho Salmon

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ABSTRACT

Significant declines in the numbers of coho salmon returning to many Thompson River/upper Fraser streams have occurred in recent years. Spawning escapements to unenhanced streams in the South Thompson were at moderate levels from 1975 through 1983. For the next six years, returns were higher, but since then there has been a decline. The proportion of South Thompson streams where no spawning coho were observed during annual inspections also increased during this period. Escapements to two enhanced South Thompson rivers (Eagle and Salmon) followed a similar pattern to unenhanced streams although the rate of decline the last nine years was greater. Returns to unenhanced North Thompson streams also followed a similar pattern although the magnitude of temporal variations was less. A period of modest returns from the mid-1970's to 1983 proceeded about 5yrs of relatively good returns. Since 1989, returns have been relatively poor. Time series of escapement data for the lower Thompson/upper Fraser were of shorter duration and greater uncertainty than for the North and South Thompson. Escapements during the four most recent years were generally lower than in previous years.

A recent preponderance of males in the spawning escapements of some Thompson streams, combined with a suggestion that there may be declines in sizes of fish at return, and a tendency for smaller females to be less fecund are also causes for concern. Each of these factors reduces the reproductive potential of the population.

An analysis of coded-wire tag data did not show any appreciable differences in the marine tag recovery patterns among South Thompson, North Thompson, and Lower Thompson/upper Fraser stocks. Although some minor differences in the marine recovery patterns of Thompson and lower Fraser coho were seen, opportunities harvest of these two stock groups separately appear to be rare. Possible exceptions are late September-October fisheries in Georgia Strait North, and coho fisheries within the Fraser River after the end of October.

Fishery managers need to be aware of potential impacts of fisheries in Puget Sound (Washington) on Thompson coho in years when conservation concerns result in reduced catches in Canadian waters. For marine waters in 1997, although sample sizes were extremely small, approximately as many CWT'ed Thompson coho were reported caught by American fishers as by Canadian fishers.

The authors conclude that at current low marine survivals, coho populations within the North and South Thompson drainages may decline even without fishing mortality. Finally, the authors warn that selective mark fisheries, unmonitored fisheries, and incidental mortality will compromise our ability to evaluate the success of measures to conserve Thompson River/ Upper Fraser coho.

RÉSUMÉ

Une réduction appréciable du nombre de saumons cohos revenant frayer dans plusieurs affluents de la rivière Thompson et du haut Fraser a été notée au cours des dernières années. Les échappées de géniteurs dans plusieurs affluents non mis en valeur de la South Thompson ont été moyennes de 1975 à 1983. On a ensuite noté une augmentation pendant les six années suivantes, mais elle a été suivie d'un déclin. La proportion d'affluents de la South Thompson où aucun coho géniteur n'a été observé pendant les inspections annuelles a aussi augmenté pendant cette même période. Les échappées de deux affluents mis en valeur de la South Thompson (Eagle et Salmon) ont présenté un régime semblable à celui des affluents non mis en valeur, mais la vitesse du déclin a été plus importante au cours des neuf dernières années. Les remontées des affluents non mis en valeur de la North Thompson ont présenté une allure semblable, mais l'envergure des variations temporelles était moins prononcée. Une période de remontées plutôt faibles a été notée du milieu des années 1970 à 1983, après quoi elles ont été relativement bonnes pendant cinq ans pour ensuite être relativement faibles à partir de 1989. Les séries chronologiques des données sur les échappées de la basse Thompson et du haut Fraser sont plus courtes et moins fiables que celles obtenues pour la North et la South Thompson. Les échappées des quatre dernières années sont généralement inférieures à celles des années antérieures.

Une prépondérance de mâles récemment notée pour les échappées de certains affluents de la Thompson liée à des indices de déclin de la taille des poissons et le fait que les femelles de petite taille aient tendance à être moins fécondes sont sources de préoccupations. Tous ces facteurs ont pour effet de réduire le potentiel reproductif de la population.

Une analyse des données du marquage par fils codés ne montre pas de variation appréciable de la récupération des fils en mer pour les stocks des rivières South Thompson et North Thompson, de la basse Thompson et du haut Fraser. Certains écarts mineurs ont été notés chez les allures de récupération en mer pour les cohos de la Thompson et du bas Fraser, mais les possibilités de récolte distincte de ces deux stocks semblent rares si l'on fait exception des pêches de fin septembre et d'octobre dans le nord du détroit de Géorgie et de la pêche du coho faite dans le Fraser à la fin d'octobre.

Les gestionnaires des pêches doivent être conscients des incidences éventuelles des pêches du détroit Puget (Washington) sur le coho de la Thompson au cours des années où les mesures de conservation donnent lieu à des captures réduites en eaux canadiennes. Dans les eaux marines en 1997, et bien que les échantillons soient

extrêmement réduits, les pêcheurs américains ont signalé avoir capturé presqu'autant de cohos de la Thompson marqués par fils codés que les pêcheurs canadiens.

Les auteurs concluent qu'aux faibles niveaux de survie en mer actuels, les populations de coho des bassins de la North et de la South Thompson pourraient décliner même en l'absence de mortalité par pêche. Pour terminer, les auteurs signalent que la pêche sélective de poissons marqués, les pêches non contrôlées et la mortalité connexe pourront compromettre notre capacité à évaluer la réussite des mesures de conservation du coho de la rivière Thompson et du haut Fraser.

INTRODUCTION

Due to the mixed stock nature of the major ocean salmon fisheries and the limited data available on coho salmon, in the past, Thompson/upper Fraser River coho were managed and assessed (along with lower Fraser and Strait of Georgia coho stocks) as a large aggregate. At an internal DFO coho conservation workshop held at the Pacific Biological Station on 21-22 January 1998, it was concluded that coho from the Thompson and upper Fraser River should be managed and assessed separately from other southern BC coho. This PSARC Working Paper is our first attempt to provide advice specific to Thompson and other upper Fraser coho.

Earlier assessments of southern BC coho salmon (e.g. Kadowaki et al. 1995; Kadowaki et al. 1996; Simpson et al. 1997) identified concerns about the status of Thompson and other southern BC coho stocks. As a result, DFO implemented numerous fishery management measures designed to reduce coho exploitation rates. Despite these measures, spawning escapements to many Thompson streams continued to decline relative to their brood year escapement (Simpson et al. 1997). The purpose of this report is to provide an assessment of the status of coho salmon from the Thompson River/upper Fraser River[1] (Figs. 1.1-1.3).

Coho from the Thompson/upper Fraser are genetically distinct from coho from the lower Fraser River and the rest of BC (Small et al. 1998a, b). Allele frequency differences amongst coho populations from the South Thompson, North Thompson, and lower Thompson/upper Fraser indicate that significant geographical substructuring within the drainage occurred (Small et al 1998a). In this PSARC Working Paper, as much as possible, we assess coho from these three areas separately. We distinguish between data from enhanced stocks and unenhanced stocks when we can.

1. ESCAPEMENT AND ENHANCEMENT

1.1 OVERVIEW OF ESCAPEMENT METHODOLOGY

Much of our assessment of the status of Thompson River and upper Fraser coho stocks relied upon analysis of spawner escapement data. The data were obtained from two primary sources: (1) counting facilities operated by DFO and the Shuswap Nation Fisheries Commission (SNFC) and (2) original field data survey forms (i.e. BC 16's) from fishery officer and other DFO staff based on stream walks. Other workers

[1] In this paper we define the South Thompson region as the mainstem South Thompson River and tributaries upstream from the confluence of the North Thompson River; the North Thompson as the mainstem North Thompson and tributaries of it; and the lower Thompson/upper Fraser as the mainstem Thompson and tributaries downstream from the confluence of the North Thompson including the Nicola watershed, plus the Fraser River and tributaries upstream of Hell's Gate, near the town of Hope.

provided escapement data as far back as 1951 (e.g. Anonymous 1997; Burt and Wallis 1997; Harding et al 1994; Serbic 1991; Williams et al. 1994); we did not use these data because they were generally of unknown accuracy and precision.

In recent years, DFO and the SNFC operated counting facilities in up to ten systems, many of which were enhanced. For instance, in 1997, counting facilities were operated in Bessette Creek, Bonaparte River, Danforth Creek, Deadman River, Dunn Creek, Huihill Creek, Lemieux Creek, Louis Creek, Mann Creek, and Salmon River. Details on fence operations in enhanced streams are provided in Section 2.2 and results are in Appendices 1, 2, and 3. Unless indicated otherwise, escapement estimates for these sites are estimates of the numbers of fish spawning naturally (rather than the total numbers returning). Estimates were not expanded to account for fish that may have passed counting fences uncounted except at the Salmon and Eagle Rivers (South Thompson) where these data were available.

We also present and use a time series of escapement estimates for more than 50 streams with little or no enhancement. Most of these estimates utilise data gathered by fishery officers and other DFO staff in the Clearwater, Salmon Arm, and Lillooet areas and are based on multiple stream walks. To generate these estimates, we went back to the original field data survey forms (i.e. BC 16's) whenever possible. While most of the estimates are of unknown accuracy, we feel many are relatively precise, and when aggregated by geographic area, provide valuable information on trends in spawner abundance (Appendices 1, 2, and 3). The data that we consider of consistent reliability for the North and South Thompson extend back to 1975. In the North Thompson, Frank Voysey generated most of the data from 1975-1990 while Tim Panko collected subsequent information until 1994. In the South Thompson, Byril Kurtz has provided a consistent data record from 1979 until the present, with the exception of 1993. In Appendices 1,2, and 3, in addition to escapement estimates, we also include information on stream lengths, and the lengths of streams accessible to anadromous coho; stream length data were obtained chiefly from Department of Fisheries and Oceans (1991 and 1992).

We filtered our escapement database to remove the confounding effects of inconsistent monitoring and enhancement. For data from the South Thompson region (Appendix 1), we present graphs of data from the Eagle River and Salmon River separately because of significant enhancement in these rivers. For the remaining systems, we present data from all systems monitored for ≥18 years out of 23 (Adams River (upper), Adams River (lower), Bessette Creek, Blurton Creek, Bolean Creek, Canoe Creek, Creighton Creek, Duteau Creek, Harris Creek, Hunakwa Creek, Kingfisher Creek, Scotch Creek, Shuswap River (lower), Shuswap River (mid), South Pass Creek, Tappen Creek, Trinity Creek, Wap Creek, and Sinmax Creek). We also present escapement estimates for those systems where an estimate was produced every year in the time series (Adams River (lower), Canoe Creek Kingfisher Creek, Shuswap River (lower), and Shuswap River (mid)). To account for missing estimate(s) in the first instance, we used the average of the numbers preceding and following the missing data, and if a missing

datum was at the beginning or end of the time series, we used the estimate for the nearest year.

For the North Thompson escapement dataset (Appendix 2), data were filtered similarly. Estimates from Louis, Lemieux, and Dunn were considered separately because of enhancement. Only two systems (Lion Creek and N. Thompson River) had escapement estimates each year, while 10 systems (Barrierre River, Blue River, Cook Creek, E. Barrierre River, Fennel Creek, Lion Creek, N. Thompson River, Raft River, Reg Christie Creek, and Tumtum Creek) had escapement estimates produced for ≥18 yrs out of 23. We did not feel two systems with continuous records were sufficient to reflect trends in abundance, so we only present figures for the 10 systems with at least 18 annual estimates. Missing data were replaced as with the South Thompson.

For the Lower Thompson/upper Fraser region, our record begins in 1984 and only exists for 12 streams (Appendix 3), of which two systems have continuous records: Bridge River (some enhancement) and Deadman River (significant enhancement). Portage Creek was missing data for three years and Seton (combined with Cayoosh Creek, a tributary) was missing data for two years. Missing data points were accounted for as previously and we present graphs for these four systems together, realizing that we are not removing the confounding effects of enhancement.

For the above datasets, we present escapement data in several ways. The first is the sum of the escapements to the particular streams. Because this approach can mask changes in abundance to streams with smaller returns, we also present weighted averages. For these graphs, each stream-year combination was averaged over the time series, and then each stream was weighted equally. For the North and South Thompson datasets, we also illustrate changes in the proportion of streams surveyed where no coho were seen.

We examined trends using the same approach as Bradford (1998). The slope of the regression of *ln* (escapement) Vs year (r_{an}) was used to estimate the annual intrinsic rates of change for each stock aggregate. Finite rates of change per year were calculated as $1\text{-}e^{r_{an}}$ and per generation rates as $1\text{-}e^{3r_{an}}$. Positive numbers indicated an increasing trend while negative numbers indicated a declining trend.

Even at counting fences, complete counts of migrating coho are rarely obtained because unknown numbers of fish often migrate past the fences during freshets. Since 1993, DFO's Stock Assessment Division carried out mark recapture programmes in Louis and Lemieux creeks (North Thompson) to generate escapement estimates of known precision. Data from Louis and Lemieux creeks and the Salmon and Eagle rivers are provided separately.

1.2 ENHANCED STREAMS AND FACILITIES

1.2.1 SOUTH THOMPSON

1.2.1.1 Eagle River and Hatchery

The Eagle River flows 81 km southwest into Shuswap Lake near Sicamous with no barriers to anadromous fish passage except during low water. The Eagle River Hatchery was approximately 32 km east of Sicamous, 40 km up the Eagle River from Shuswap Lake. It consisted of incubation and rearing facilities for coho, chinook, and rainbow trout and an adult enumeration fence. Eagle coho were enhanced from 1983 until the hatchery closed in 1993.

Various release strategies were evaluated: spring fry, fall fry, and smolt releases. All release groups were consistently tagged. Mean annual fry releases, a mixture of spring and fall fry, were 456K overall, dropping slightly to 413K in the 1990's. Smolt releases averaged 46K overall and 61K in the 1990's (Table 2.1).

Adult fence counts were made throughout the migration period from 1986 to 1996, although fence breaches did occur. Escapement data were adjusted based on average timing. In 1997 the fence was not operated and the counts from two float surveys were expanded to give an escapement estimate.

1.2.1.2 Salmon River (Salmon Arm)

The Salmon River flows 149 km northeast, entering Shuswap Lake at Salmon Arm. Salmon can access 80 km of river. Fry were out-planted during spring from Eagle River Hatchery from 1984 to 1991 and in 1993, and fall fry were planted in 1994. Beginning with the 1994 brood, Salmon River coho have been enhanced from the Spius Creek facility. Overall, the average annual fry release was 203,000. The peak was 1990 when 531,000 were released. About 10,000 and 21,000 smolts were released in 1993 and 1994 (Table 2.1).

Adult fence counts were made from 1986 to 1997, with fence breaches in some years. Escapement data were adjusted based on average timing of the run.

The Salmon River has been the topic of two recent DFO publications (Burt and Wallis 1997; Miles 1995).

1.2.1.3 Mid-Shuswap Facility and Bessette Creek

Bessette Creek flows 38 km north-east into the Shuswap River, near Shuswap Falls, with no known barriers to fish passage. An adult coho fence has been operated on the creek since 1994 (Galesloot 1995; Galesloot 1997; Ross and Galesloot 1997). In 1996

a decision was made to enhance Bessette coho. Eggs were incubated at Shuswap R. Hatchery, initially reared at the small Kingfisher Creek Hatchery, then transferred back to Shuswap Hatchery for tagging and final rearing. No brood stock were taken in 1997 due to the extremely poor run.

1.2.2 North Thompson

1.2.2.1 Clearwater Hatchery

The Clearwater Hatchery is on the Clearwater River approximately 2km upstream from the Thompson River confluence in the community of Clearbrook. It was built mainly to enhance chinook but included some coho enhancement. Coho targets were never realised, with only small numbers of eggs taken from Lion Creek, Dunn Creek, and Raft River between 1984 and 1986. Releases were all spring fry. DFO ceased operating the facility in 1992 and it is now operated by MOELP. Dunn Creek, Louis Creek and Lemieux Creek fry were reared over the summer at the facility for several years due to a high water temperature problem at the Dunn Lake Facility.

1.2.2.2 Dunn Lake Hatchery

Dunn Lake (3.7 km^2) is drained by Dunn Creek, a tributary of Joseph Creek which enters the North Thompson River from the east, just upstream from Little Fort. The watershed area is 105 km^2. The Dunn Lake facility was constructed in 1982 to provide employment and training for the North Thompson Indian Band and to enhance North Thompson coho. Dunn Creek, Lemieux Creek, and Fennell Creek were the original three stocks enhanced. In 1988 Fennell Creek was replaced with Louis Creek stock, which had been enhanced for several years by a Public Involvement group.

In 1982 the project consisted of a small hatchery on Dunn Creek, with an intake from Dunn Lake, containing bulk upwelling incubators and a rearing trough. Fry were moved in the fall to net pens in Dunn Lake to rear over-winter but poor survivals, due to high water temperatures during the summer, necessitated hatchery rearing, first at Clearwater Hatchery and lately at Spius Creek Hatchery. In 1997 the hatchery was upgraded by adding a new intake from Dunn Creek and four concrete raceways and six Capilano troughs for rearing. A second intake from Boulder Creek, which has cooler water, is planned for this year. These improvements should make it possible to rear the fry for fall or smolt releases without high mortalities.

The present release targets are: Dunn Creek - 10K fry and 20K smolts; Lemieux Creek - 15K fry and 20K smolts; and Louis Creek - 15K fry and 20K smolts (Table 2.1). In 1997, approximately 35K eggs were taken from each of Dunn and Lemieux creeks and 18K from Louis Creek. Coded-wire tagging on all stocks has been fairly consistent since 1982.

An adult enumeration fence is maintained on Dunn Cr. and escapement counts are made in most years. Fry releases have decreased to an average of 24K in the 1990's with none in 1996 or 1997. Smolt releases have averaged 18-19K since 1988 (Table 2.1).

1.2.2.3 Lemieux Creek

Lemieux Creek flows 40 km in a southerly direction before entering the west side of the North Thompson River at Little Fort. A drainage area of 282 km^2 includes Taweel Lake and three tributaries. Abundant side channel habitat, a gravel and cobble substrate, numerous beaver dams and plentiful woody debris characterise Lemieux Creek. Impassable falls are located at km 13 making the upper reaches inaccessible to anadromous fish. A substantial groundwater influence moderates winter temperatures allowing major spawning areas to remain ice-free. Lemieux has had coho fry plants (mostly before 1991) and mean smolt releases of 18K since 1990 (Table 2.1). Dunn Lake Hatchery is the rearing facility.

A counting fence has been operated Lemieux Creek since 1986 ~1.5 km upstream of the confluence with the North Thompson River. Initially the fence was used as a brood stock capture site and escapement estimates were not made using fence data. Since 1993, unexpanded counts of fish released at the fence (Appendix 2) have been used as a proxy for spawning escapement upstream of the fence and are compared with mark recapture estimates of the same population.

In the fall of 1993 the population of juvenile coho in the stream was estimated by a mark recapture study to be ~32,000 (J. Irvine, unpub. data).

1.2.2.4 Louis Creek

Louis Creek flows 66 km in an easterly direction before entering the east side of the North Thompson River at the town of Louis Creek. A drainage area of 512 km^2 includes Eileen Lake and six high gradient tributaries that offer little useable salmon habitat. A meandering, single channel bordered by agricultural land characterises Louis Creek. Extensive agricultural and recreational use has resulted in silting and stream bank erosion in some areas (Harding et al. 1994).

Like Lemieux, Louis Creek is one of the few interior streams where intensive escapement estimates are made so it has been used as an indicator despite on-going enhancement (fry and smolt releases from Dunn Lake Hatchery). Mean annual smolt releases of 14K have been made since 1990. Fry plants have decreased in size to an annual average of 13,100 since 1990, and none in 1996 or 1997 (Table 1). Wild smolts have not been enumerated.

A fence in Louis Creek was installed in 1985 ~10 km upstream of the confluence with the North Thompson River. Initially the fence was used primarily for brood capture but since 1993, unexpanded counts of fish released at the fence (Appendix 2) have been used as a proxy for spawning escapement upstream of the fence and are compared with mark recapture estimates.

1.2.3 LOWER THOMPSON/UPPER FRASER

1.2.3.1 Deadman Hatchery

Deadman River flows south into the Thompson River, 4 km west of Kamloops Lake and has a watershed area of 1,495 km^2. Deadman Hatchery is run by the Skeetchestn Indian Band. It was built in 1983 to provide employment and training for the band and to enhance coho and depressed chinook stocks.

The hatchery consists of moist and cassette incubators, earthen rearing channels and a large rearing pond. Target releases are set at 30K 1+ coho. There have been various problems resulting in poor in-hatchery survival, especially during the initial rearing phase for coho. Spius Creek Hatchery assisted with production of Deadman coho in 1996.

Although counts of adult coho have been made at a counting fence in the lower river since 1992, data quality has been variable.

1.2.3.2 Nicola River Watershed and Spius Creek Hatchery

Spius Creek Hatchery enhances two stocks in this area, Coldwater River and Spius Creek, both tributaries of the Nicola River. Coldwater River flows 90.4 km north, joining the Nicola River at Merritt. The drainage area of 914.9 km^2 includes many small tributaries. Enhancement began with a pilot fry release in 1985 and has continued with fry and smolt releases since then. 1997 was the first year with no fry release, due to a very low adult return in 1996.

Spius Creek flows 48.6 km north, joining the Nicola River near Canford. The drainage area of 780.2 km^2 includes one main tributary, Maka Creek. Enhancement began with fry releases in 1987 and the first smolts were released in 1995. The present target is for releases of 20K fry and 80K smolts from each brood year. Coho returns to Spius Creek can be the largest in the Thompson drainage (e.g. 1997).

A fence on the Upper Nicola River (above Nicola Lake) provided a count for 3yrs.

2. STOCK STATUS BASED ON ESCAPEMENT RECORDS

2.1 SOUTH THOMPSON

Regardless of whether the dataset for 19 streams with at least 18 yrs of observations are used (Figures 3.1 and 3.2), or the dataset for the 5 streams with complete records (Figures 3.3 and 3.4), the pattern for coho returns to the South Thompson is the same. Escapements were at intermediate levels from 1975 through 1983, they increased until about 1989, after which they declined, with 1992 returns being anomolously high for the most recent period. The index escapement figures (Figures 3.2 and 3.4) illustrate the years when escapements were above or below long-term averages (i.e. > 1 or < 1 respectively). For each dataset, 1996 had the lowest returns on record, and although there was an improvement in 1997, escapements were still less than the brood year (1994), and much less than the average.

Trend analysis confirmed that populations increased during 1975-1988 and declined thereafter. Unenhanced coho in the South Thompson declined at 54% per generation since 1988 (Table 3.1; Bradford 1998) but increased at 30% per generation during 1975-1988.

It is interesting that returns to the two enhanced rivers, Salmon and Eagle (Fig. 3.5), followed similar patterns as the unenhanced streams. The very low returns in 1997 are probably in part because of reduced enhancement, and may be biased low because the fence on the Eagle River was not operated.

The proportion of South Thompson streams inspected with no spawning coho seen (Figure 3.6) generally increased during the time series, indicating that returns were worse in recent years than they were earlier. In 1996 for instance, coho were not seen in 48% of South Thompson streams examined, compared to an average of 14% over the entire time series.

2.2 NORTH THOMPSON

Escapements to the unenhanced North Thompson aggregate (Figures 3.7 and 3.8) followed a similar temporal pattern as returns to the South Thompson, except the magnitude of temporal variations was less. A period of modest returns from the mid-1970's to 1983 proceeded about 5yrs of higher escapements. Since 1989, returns were usually lower with the 1990 brood line being particularly bad. Escapements in 1997 were better than in 1996, and in some cases exceeded the brood escapement, while in other instances, did not.

Escapement patterns for coho returning to the three enhanced North Thompson tributaries prior to 1994 were less evident than for other stock aggregates (Fig. 3.9). Returns the last three years have been poor, similar to the other stock groups.

Trend analysis demonstrated that North Thompson coho populations increased during 1975-1988 and declined thereafter (Table 3.1). Compared to the South Thompson dataset, rates of increase during the first time period and rates of decrease during the second time period were less for North Thompson fish.

The proportion of North Thompson streams inspected with no coho seen (Figure 3.10) generally increased during the time series. No coho were seen in more than one-third of the streams visited the last four years.

2.2.1 Louis-Lemieux Results

The mark recapture programmes in Louis and Lemieux creeks provided estimates of known precision of the numbers of fish returning with and without cwt's. Adding numbers taken for broodstock at the fences and other known mortalities to the spawning escapement yielded estimates of the total numbers returning to each stream (Table 3.4).

The return to Louis Creek in 1997 was the lowest in this short time series (49% of mean escapement), and significantly less than the brood year escapement. During 1993-1997, with the exception of 1993, the unexpanded fence count provided a reasonable estimate of the spawning escapement.

The return to Lemieux Creek in 1997 was 88% of the mean return since 1993 (Table 3.4). The total return in 1997 was significantly less than the brood year escapement. The Lemieux fence count was less precise an indicator of total run size than the fence in Louis Creek; between 1993-1997, the fence count ranged from 33 to 94% of the total run size.

2.3 LOWER THOMPSON/UPPER FRASER

Declining returns to streams in the lower Thompson/upper Fraser (Figures 3.11 and 3.12) were less evident than in other areas, although the time series was shorter. Escapements during the most recent four years were generally lower than in previous years. Lower Thompson coho escapements declined during the 1988-1997 period as did upper watershed populations, but the rate of decline in the lower Thompson was slower (Table 3.1).

3. BIOLOGICAL CHARACTERISTICS OF THOMPSON COHO[2]

3.1 SIZES

Data were assembled for Coldwater, in the Thompson mainstem, and Dunn and Lemieux, in the North Thompson, (Table 4.1). For all three streams, the average lengths for females were greater than those for males, but while in some years differences were significant (e.g. Coldwater 1988), in other years, they were not (e.g. Coldwater 1989). No trends for males or females were found. In 1997, Dunn male and female coho were significantly smaller than for any previous year. Unfortunately, lengths were not taken in either 1995 or 1996 for Dunn so it was impossible to tell if there had been a recent downward trend in size. However, 1995 and 1996 lengths for Lemieux Creek showed no downward trend so the 1997 result for Dunn may be an anomaly.

Field staff have mentioned a belief that North Thompson coho are smaller than other Fraser River stocks. We found no significant differences among these three Thompson stocks, and have not compared these data with length statistics for other populations of coho.

3.2 FECUNDITIES

Fecundity estimates are provided for coho returning to: Salmon River (South Thompson), Louis, Lemieux, and Dunn (North Thompson), Coldwater, Spius, and Deadman (Lower Thompson) and Chilliwack and Inch (Lower Fraser) (Table 4.2). There are two weaknesses with these data that must be appreciated. First, fecundities are not always based on sampling individual females but sometimes by counting (or estimating) the total numbers of eggs surviving at the eyed stage plus egg mortalities from green to eyed, then dividing that total by the number of females used. Second, unknown numbers of females may have been partially spawned or green. Therefore, our fecundity estimates may be biased low.

From these data, it appears that mean fecundities of coho returning to Thompson streams are less than those for coho returning to hatcheries in the lower Fraser. Fecundities at Chilliwack and Inch Creek were similar to the mean fecundity of BC coho salmon (2470) reported by Sandercock (1991). Mean annual fecundity estimates for Thompson stocks were always less than this[3]. Within the Thompson, there were no clear geographic patterns in fecundities.

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[2] Additional data are provided in Galesloot (1998) which are not incorporated into our assessment document.

[3] Ross and Galesloot (1997) reported the mean fecundity of six coho taken in Bessette Creek, South Thompson in 1996 to be 2356 eggs.

Coho returning the last several years were generally less fecund than coho returning earlier. This trend occurred for coho in the Thompson and the lower Fraser (Table 4.2).

3.3 SEX RATIOS AND AGES

With the exception of coho returning to the Eagle River, males outnumbered females in each system in recent years (Table 4.3). Males outnumbered females at Dunn, Lemieux, and Louis (North Thompson) the last 8, 7, and 6 years respectively, and at Deadman (Lower Thompson) and Salmon (South Thompson), the last 4 and 2 years respectively.

Jacks (one summer at sea) were not recorded except at three South Thompson rivers, Eagle, Salmon, and Bessette (Table 4.3). However, as these age designations were based on the sizes of the returning fish, and have not been validated by scale analysis, it is possible that fish recorded as jacks were small males of normal age.

We have limited age data from scale analyses from coho returning to Louis and Lemieux in the North Thompson and Bridge and Deadman in the lower Thompson/upper Fraser (Table 4.4). Most Thompson/upper Fraser coho appear to go to sea in their second year (European age 1._) with a small number remaining for one more year (age 2._). Fish returning to Louis and Lemieux in 1996 appeared to show higher than usual rates of long fresh water rearing (ages 2.1 and 3.1). Individual scale ages need to be compared with CWT ages to determine whether this was an ageing error.

Almost all of the Thompson/upper Fraser coho aged spent over one year in salt water. Jacks (age 1.0) were rare, as were fish that spent more than two years in salt water (age 1.2) (Table 4.5).

4. CATCH INFORMATION

4.1 FRESHWATER CATCH STATISTICS

4.1.1 Sport Fisheries

Sport fisheries for coho salmon in the Fraser River and tributaries, above Alexander Bridge, closed in 1996. From 1989-1995 the only adult coho (>50cm) sport fishery in the upper river occurred in the Eagle River on the larger returns of enhanced fish. Fishing was closed after 1995 due to declining escapements and the closure of the Eagle River hatchery in 1993. Catches were low relative to abundance in all years (Table 5.1). Prior to 1989, there were coho catches in the mainstem Fraser River from Boston Bar to Lillooet, at the confluence of tributaries including Nahatlatch River, Stein River and Thompson River, and in the Thompson River, primarily from Lytton to the

Nicola River. There are limited data available on catch and effort. The North and South Thompson rivers had restrictive sport fisheries for coho during the 1970's and 1980's. These were reported to be very limited effort and only rarely was a coho reported caught.

Coho of Thompson origin are also angled in the lower Fraser River. This fishery was assessed during 1985-1988 (Schubert 1992). Between 3400 and 9300 adult coho were caught (harvest plus release) annually but many of these fish would of been of lower Fraser origin. The lower river sport fishery was assessed again commencing in 1995 (Bratty et al. 1998; Walter et al. 1998) but for these years, the creel survey was terminated before the major coho migration period. We therefore do not have a reasonable estimate of coho harvest in the lower Fraser River for recent years.

4.1.2 Native Fisheries

From the mid 1970's to present there has been very limited effort by First Nations peoples directed at coho salmon. The preferred species based on catch and effort are sockeye and chinook. Most harvests of coho in recent years occurred at the enumeration fences on enhanced stocks with adipose clipped coho harvested both for food and to facilitate the recovery of coded wire tags. Harvests have occurred terminally in Louis Creek, Lemieux Creek, Dunn Creek, Eagle River, Shuswap River, Salmon River and Spius Creek, as well as on passing stocks in the lower Thompson River (dip net, spear, angling) and the Fraser River (gillnets). Since 1995, fishing in the lower Thompson and Fraser rivers has been restricted during October and November. Generally effort in these areas decreases significantly after mid-September and the sockeye salmon migration. In 1996 and 1997 the First Nations voluntarily further restricted their fisheries to conserve coho. Catches are recorded as the North Thompson and tributaries; South Thompson and tributaries; and the Thompson River and Fraser River between Sawmill Creek and Kelly Creek (Table 5.1). Native catches in the lower Fraser River can be calculated from data in Table 5.1. Most of the coho caught in the lower Fraser are presumably of lower Fraser (rather than Thompson) origin.

4.2 MARINE CATCHES AND RECOVERIES OF CODED WIRE TAGS

Coded wire tags from Thompson and Lower Fraser River coho are recovered in fisheries from Alaska to Washington State. The vast majority of Fraser and Thompson coho are taken in troll and sport fisheries off the west coast of Vancouver Island and in Georgia Strait. Net fisheries for other species in Johnstone Strait, Juan de Fuca, Georgia Strait, San Juan, and in the Fraser River also harvest Fraser and Thompson coho incidentally. In previous years all fisheries north of the northern tip of Vancouver Island (including fisheries in Alaska) accounted for one percent or less of the estimated recoveries of tagged coho from the Fraser and Thompson systems (Fig. 5-1). With the closing of the West Coast Vancouver Island troll fishery in 1997, the troll, net and sport

fisheries of the central and north coast accounted for two and eight percent of the estimated recoveries of Thompson and Fraser coho tags respectively (Fig. 5-1).

Canadian fisheries that directly or indirectly harvest significant numbers of southern BC coho saw unprecedented restrictions during 1997. Commercial fisheries in the south coast were required to release all coho, and on-board observers estimated the number of coho released. Total coho mortalities were estimated from the number of coho released and the estimated mortality rate for released coho in each fishery. Total mortality limits were set in all fisheries to reduce catch to 20-25% of the estimated abundance of inside stocks of south coast coho. Each fishery was managed to a share of the total allowable mortality (TAM). The troll fishery off the west coast of Vancouver Island was closed to coho fishing in 1997, and troll fishing opportunities for chinook were curtailed to limit the incidental harvest of coho. Seine net fisheries (primarily for sockeye) were required to release coho. The coho sport fisheries off the West Coast of Vancouver Island, in Juan de Fuca and Georgia Strait remained open. The coho bag limit in Juan de Fuca and off the West Coast was reduced to two coho per day. Sport fisheries accounted for approximately 86% of the landed catch (small numbers of coho were landed in error during seine net fisheries) and 73% of the total estimated mortality of southern BC coho in Canadian marine fisheries in 1997.

4.2.1 Recoveries of Coded Wire tags

Coded wire tag recoveries were obtained from the MRP database maintained on the PBS VAX computer. Recoveries of CWT's from Washington State fisheries for 1997 were included in this analysis. CWT's could not be recovered from Southern BC commercial fisheries in 1997, because most coho were released. Southern BC sport fisheries were sampled, as were commercial fisheries north of Vancouver Island, and US fisheries in Washington and Alaska.

Estimated recoveries (observed recoveries multiplied by the catch:sample ratio) were used for all analyses. No expansion factors were available for Washington sport recoveries. An expansion factor of four (assuming that 4 coded-wire tagged coho were caught for each tagged coho recovered) was used because similar expansion factors were observed for 1996 in the same fisheries. Marine harvest distributions excluded tags recovered from freshwater (non-tidal) sport and Fraser gill-net fisheries. Southern Georgia Strait sport included recoveries for Area 29, which includes marine waters as well as freshwater tidal portions of the Fraser River below the Mission Bridge. The tidal freshwater below the Mission Bridge supports an active coho sport fishery. Coded wire tags are not recovered from most First Nations fisheries including those in the Fraser River. Total catches in these fisheries have declined steadily, and now comprise less than one half of one percent of the total coho catch in southern BC.

4.2.2 Distribution

This analysis was intended to identify differences in the spatial and temporal patterns of harvest of Thompson and Lower Fraser coho. Where there were sufficient recoveries, data were analyzed separately for North Thompson (Louis, Lemieux and Dunn Creeks), South Thompson (Salmon and Eagle Rivers), Lower Thompson (Deadman and Coldwater Rivers and Spius Creek) and Lower Fraser (Salmon, Chilliwack, Chehalis, and Upper Pitt rivers, and Inch Creek) stocks.

Patterns of tag recoveries are determined by a number of factors including the distribution and abundance of tagged fish, the distribution and type of fishing effort and the effectiveness of the sampling program used to recover tags. The proportion of total estimated tags recovered by fishery provides the best measure of fisheries impacts on the tagged stock. When sufficient tags are recovered, catch per effort (CPUE) of tagged fish provide insight into the relative abundance of tagged fish within a particular fishery over time (for a particular fishery and year), but only if effort is well understood and documented. In sport and troll fisheries, effort can be difficult to quantify. Most fishers will encounter more coho in a day spent fishing for coho than during a similar day spent fishing for chinook or sockeye. In general, total effort (in boat days) is known but quality of effort is not. Changes in the length of the fishing trip, the number of lines fishing, or the target species for the trip are not well documented. Analysis of catch per effort of tagged fish can be useful in adjusting for major changes in effort in order to examine changes in abundance of tagged fish in the fishery over time. For the most part our analysis looked at fishery impacts in order to identify opportunities to reduce these impacts. The sport fishery in Juan de Fuca and the net fishery in the lower Fraser River are located on the migration route for Thompson coho. We looked at CPUE in these two fisheries in order to estimate the abundance of tagged fish vulnerable to these fisheries through the season.

The catch distribution of Fraser and Thompson coho is dominated by dramatic swings between inside and outside fisheries. During the 70s and 80s, large numbers of coho remained inside Georgia Strait each year and supported large sport and troll fisheries (Simpson et al. 1997). In 1991, 1995, 1996, and 1997, the majority of coho appeared to leave Georgia Strait. The dramatic effect of this apparent exodus on recovery patterns of coded wire tagged Thompson and Fraser coho can be seen in Figure 5-1. In 1993, most Thompson and Fraser coho were taken in Georgia Strait, while in 1996 most were taken off the West Coast of Vancouver Island. Coho showed strong outside movement again in 1997. Very few coho were harvested in Georgia Strait, but troll fisheries off the West Coast of Vancouver Island were closed and few CWT's were recovered.

Figure 5-2 summarizes the gross ocean distribution of tag recoveries for North, South, and Lower Thompson and Lower Fraser groups. While hampered by lack of recoveries in several strata, the available data provide no indication that coho from the three geographic regions of the watershed have unique ocean distributions. There are minor differences between the distribution of Thompson tag recoveries and those from the Lower Fraser. In 1993 (an inside year), a larger proportion of Lower Fraser tags was taken inside, and a smaller proportion was taken in US fisheries. The proportion of

Thompson and Lower Fraser Cwts recovered in Washington State increased dramatically in 1997 (Fig 5-2). This was not entirely unexpected for three reasons. First, conservation measures reduced the recovery of tags from Canadian fisheries. Second, conservation measures in Canadian outside fisheries (particularly in an outside year like 1997) increased the relative abundance of Canadian inside coho stocks moving through US waters. Finally, high inside diversion of sockeye in 1997 (i.e. through the inland waters of Georgia Strait rather than along the outside of Vancouver Island), resulted in low numbers of sockeye available to fishermen in Washington State. This in turn resulted in extended fisheries by US seine and gill-net fleets along the Canada US boundary at Point Roberts and in San Juan and Juan de Fuca as the US fishers worked to harvest what they perceived to be their share of the Fraser sockeye return. Fraser and Thompson coho were harvested incidentally in these fisheries.

4.2.3 Temporal Patterns of Tag Recovery in Marine Fisheries

Tag recoveries by month were plotted for the major South Coast coho fisheries to identify times and areas when Thompson coho might be uniquely vulnerable or resistant to fishing pressure. All Thompson tag recoveries were combined for this analysis because of low numbers of observed tags, and because there was little apparent difference in annual distribution of tag recoveries within the Thompson. Juan de Fuca sport was the only area with sufficient recoveries for analysis in all three years (1993, 1996, and 1997). For the north and south west Vancouver Island troll and the north and south Georgia Strait sport fisheries, tag recovery patterns for 1996 and 1993 were compared. In all southern sport fisheries, the minimum size limit was changed in 1995 from 30 to 41 cm dramatically reducing the coho harvest prior to June.

4.2.3.1 Juan de Fuca Sport

CWT recovery patterns for Fraser and Thompson coho in Juan de Fuca were different in each of the three years, but remarkably similar within each year (Figure 5-3). In 1993 (an inside year), recoveries peaked in June and declined through August, with very few recoveries in August, September, or October. In 1996 and 1997 (outside years), tag recoveries and tag CPUE peaked in September. We speculate that this reflects the harvest of coho moving from the West Coast of Vancouver Island through Juan de Fuca to the Fraser. Note that in 1996 and 1993 tags were submitted by sport fishers that were recorded as caught in October, but no effort estimate was available.

4.2.3.2 Georgia Strait Sport

CWT recovery patterns for Fraser and Thompson coho in both north and south Georgia Strait show the effects of the smaller size limit in 1995 (Figs 5-4 and 5-5). Thompson and Fraser recovery patterns were similar within each year, but the small numbers of

Thompson tags recovered in 1996 weakened the analysis. The increased numbers of Lower Fraser recoveries in south Georgia Strait in October of 1996, and in October, and November of 1993 likely resulted from the inclusion of tags recovered from the tidal fresh-water portion of area 29.

4.2.3.3 West coast Vancouver Island Troll

The CWT recovery patterns of Thompson and Lower Fraser coho were similar to one another each year, but differed between 1993 and 1996 (Fig 5-6 and 5-7). In 1993, the troll fishery opened and peaked in July and declined through September. The very low number of tag recoveries for July in the north west troll in 1996 resulted from very low effort as most of the fleet was in the south (Bill Shaw, DFO Nanaimo, pers. comm.) The rapid decline in tag recoveries in both the NWTR and SWTR in 1993 probably represented a combination of reduced abundance due to fishing and the inside distribution. It is significant to note that both the NWTR in 1996 and the SWTR in both 1996 and 1993 showed Thompson tag recoveries through September.

4.3 TEMPORAL PATTERNS IN THE LOWER FRASER RIVER

Two techniques are available to help us understand the impacts of fisheries on Thompson and Fraser coho; recoveries of coded wire tags, and DNA analysis. Cwts have been in use for over twenty years, and provide insight into the general patterns of ocean distribution, and timing of movement through fishing areas (when sufficient numbers of tagged fish are recovered). Cwts cannot provide direct estimates of the stock composition of the catch, because very few stocks are tagged, and the mark rate (the ratio of tagged to untagged production) is unknown within large production areas like the Fraser or Thompson. DNA analysis shows promise as a method of estimating the stock composition of the catch, particularly for determining the contribution of large and genetically unique production areas to major fisheries.

4.3.1 Coded Wire Tag Recoveries

The Fraser River is closed to gill net fishing beginning on Labor Day, chiefly to protect Harrison River chinook. This closure has extended well into October in recent years to protect Thompson steelhead (and in 1997 to protect Thompson coho). Prior to 1991, commercial fisheries were common through September and October, directed at late migrating sockeye, pink, and chum salmon. The highly variable nature of this fishery makes comparisons of tag recovery patterns among years difficult. Tags are also recovered from coho taken in test fisheries for sockeye, pink, chinook, and chum. To combine these data on a more equal footing we calculated the average catch of tagged Thompson coho per boat day by statistical week from 1986 to 1994 (Fig 5-8). These data show that Thompson coho begin to enter the lower Fraser in small numbers in August, increase sharply in mid September, and continue to be vulnerable to net fisheries in the lower Fraser through the end of October.

4.3.2 DNA Stock Identification

In 1997, tissue samples were collected from coho during several sampling programmes in the lower Fraser River, and subsequently analysed by the Genetics Lab. at PBS to evaluate stock compositions. Samples were gathered during a selective tangle net (3.5 inch gill net) fishery, a pink salmon mark recapture programme (beach seine), and a test fishery (Albion, multipanel gill net, 5, 6, 7, and 8 inch mesh gill net). Stock composition was determined using both microsatellite DNA and major histocompatibility complex variation for coho salmon.

Timing patterns for Thompson coho were reasonably consistent in the various samples (Table 5.2), while the estimated proportions of Thompson fish in each sample varied considerably. The difference in proportions of Thompson fish among the various samples is not surprising given the selective nature of each sampling technique. Thompson fish made up the largest proportion of each catch sample early in the study, and were relatively rare after early October. In general, these results support those from our analysis of coded wire tags in the lower Fraser in the previous section.

5. MARINE SURVIVALS AND FISHERY EXPLOITATION RATES

Due to limited coded-wire tagging of juvenile coho in the Thompson, and even more limited assessments of returns of coded-wire tagged adults returning to spawn, our understanding of marine survivals and exploitation rates for Thompson coho is not as good as we would like it to be. In addition, because a creel survey in the lower Fraser has not always operated throughout the coho migration, it is probable that in-river catches of Cwt'ed fish have been under-estimated. This means that our estimates of marine survival and fishery exploitation (Table 6.1) may be biased low. This is particularly so for 1997 because of higher than normal incidental mortality and illegal retention. Results for Lemieux and Louis creeks in the North Thompson are preliminary because there was some straying of fish amongst Dunn, Louis, and Lemieux creeks and these strays have been ignored in this analysis, as have a few fish that returned as four year olds. Also, we do not have the results from the analysis of cwt's from the fence sites in 1997. Table 6.1 contains the information that we have where we are reasonably confident in the escapement estimates of Cwt'ed fish; consequently information from fish Cwt'ed returning to Dunn Creek, Spius Creek, and Coldwater River is not included.

Calculated fishery exploitations averaged ~65% over the period of record (Fig. 6.1). The lowest exploitation rated occurred during 1997, no doubt because of the major fishery restrictions instituted that year. Although sample sizes were extremely small for the 1997 return year (only 20,000 Cwt'ed smolts released), the authors point out that the majority of the reported catch took place in Washington fisheries (Table 6.1). This is the same pattern found when the catch distribution for a larger data set was examined (Fig 5-2).

The survival data in Table 6.1 are estimates of the survival from the time of tagging until maturity. Freshwater and marine survivals cannot be separated for those fish tagged as fry. Eagle and Salmon River smolt survival data are difficult to interpret, partly because of variable stocking densities. We have most confidence in the estimates of survival for coho tagged as smolts and released in Louis and Lemieux creeks.

Smolts released into Louis Creek appeared to survive better than smolts released into Lemieux Creek although sample sizes were small. Marine survivals were lowest for the most recent brood. The average estimated survivals for fish returning in 1995, 1996, and 1997 were 2.9, 3.7, and 1.2% respectively.

6. DISCUSSION

Fewer coho salmon are returning to Thompson/upper Fraser River than they did historically. There is a clear geographic pattern with coho populations in the South Thompson doing more poorly than coho from the North Thompson. Returns the last two years to wild streams in the South Thompson ranged between 15 and 25% of longer term averages while data from two enhanced rivers (Salmon and Eagle) suggest that returns to these streams were worse (Table 7.1). Because we were not able to remove the confounding effect of enhancement from the latter data, and since the most recent counts may be biased low, we suggest that the escapement patterns to the wild stream aggregates are the most appropriate indicator of the relative abundance of coho in the South Thompson.

Returns to unenhanced North Thompson streams the last two years are only about one-third of what they were over longer time periods (Table 7.1). Escapements to enhanced streams are somewhat better. The dataset for the lower Thompson/upper Fraser is of shorter duration than for other regions, and of poorer quality, but indicates that fish in these regions are doing better than fish in the North and South Thompson watersheds.

It is not clear why the rate of decline for coho from the South Thompson is steeper than for other areas. We have no evidence that different rates of decline are the result of varying levels or rates of change of freshwater habitat degradation. Although there are many examples of habitat degradation causing reductions in carrying capacity for juvenile coho in the South (and North)Thompson (e.g. Anonymous 1997), this does not appear to be occurring at a greater rate in the South Thompson than in other areas. Freshwater habitat of course is essential for production of coho, and it is imperative that habitat quality be monitored and maintained if we wish coho populations to have the potential to rebuild.

Coho from the South Thompson are the furthest from the ocean of all Fraser coho. Other coho on the outer ranges of their natural distribution (e.g. coho from California,

Oregon, and upper Skeena) are also doing poorly. It is possible that coho from these areas are less productive (lower freshwater and/or marine survivals) than many others, and during periods of low natural survival, they suffer the most. One plausible explanation for lower productivity for stocks far from the ocean is the extra distance these fish have to migrate, both as smolts and adults. This has not been adequately examined in the literature although Sawada (1993), examining coho from the Keogh River on Vancouver Island, documented that within this watershed, coho smolts that had the longest distance to migrate to the ocean had the lowest survivals.

Coho that utilise lakes for rearing are generally less productive than coho that rely on lotic environments (L. B. Holtby, Pacific Biological Station, pers. comm.; Sawada 1993). The South Thompson is different from the North and Lower Thompson in that it is dominated by several large lakes, notably Adams, Shuswap, Mara, and Mabel. These lakes have been confirmed to be important for young coho (e.g. Anonymous 1997; Russell et al 1980), but it is not known what proportion of coho in the South Thompson rely on lakes for rearing. South Thompson coho may be less productive than other Thompson stocks because of a dependence on lakes.

Regardless of what is responsible for the rapid decline of Thompson coho, at current low marine survivals, it appears that populations within this stock aggregate may decline even without any fishing mortality. To illustrate this, consider that the total escapement of unenhanced coho to the North and South Thompson aggregates rivers in 1997 (i.e. Figs. 3-1 and 3.7) was about 1350 fish, while in 1994, about 2100 fish returned to these streams. Assuming exploitation rates in 1997 to be approximately 35%, about 730 coho from these stocks were killed that year in fisheries. All things being equal, if there had been no fishing mortality in 1997, escapements of wild Thompson coho to these rivers would have increased from 1350 to 2080 (i.e. 1350+730) coho, slightly below the brood year escapement of 2100.

The CWT data that we presented did not show any appreciable differences in the marine tag recovery patterns among South Thompson, North Thompson, and Lower Thompson/upper Fraser stocks. Although some minor differences in the marine recovery patterns of Thompson and lower Fraser coho were seen, opportunities to separate harvests of these two stock groups appear to be rare. The possible exceptions would be late September-October fisheries in Georgia Strait North, and coho fisheries within the Fraser River after the end of October.

The impact of Washington fisheries on Fraser and Thompson coho stocks in 1997 is cause for concern. Conservation measures in Canadian fisheries will need to be extreme if Washington fishers continue to capture significant proportions of Fraser, Thompson, and other southern BC coho.

7. CONCLUSIONS

Populations of coho in the Thompson declined significantly over the last 20 years. This decline is particularly severe in the South Thompson. Average escapements the two most recent years in wild systems of the South Thompson were about one-fifth of long term means while in the North Thompson, about one-third of long-term means.

Escapements in 1997 were often less than the brood escapement indicating that the 1997 fishery management measures were insufficient to halt declines for many Thompson coho populations. It appears that at current low marine survivals, declines may continue for some populations of Thompson coho independent of fishing. Fishing mortality will increase risks to stock.

A better understanding of stock dynamics for Thompson coho could be obtained by larger releases of Cwt'ed fish, and better assessments of returns. We also need to conduct a more thorough analysis of cwt information.

The implementation of a selective mark only fishery will hamper our ability to assess Thompson coho. There are no large hatchery release groups for either the South or North Thompson so we will be required to pair any tag releases from these areas with fish released and Cwt'ed at either Spius Creek or Coldwater River in the Nicola drainage. Nicola fish may have different marine distributions from North and South Thompson coho, and consequently may be vulnerable to different fisheries. Consequently, future estimates for marine survival and fishery exploitation will be less precise. Errors in mark recognition and angler compliance rates both will compromise our ability to assess Thompson coho.

DNA technology was useful in distinguishing between major stock groups within the lower Fraser. DNA analysis shows promise as a method of estimating the stock composition of the catch (freshwater and marine), particularly for determining the contribution of large and genetically unique production areas to major fisheries.

A recent preponderance of males in the spawning escapements, a suggestion that the sizes of fish returning is declining, and the tendency for smaller females to be less fecund, are causes for concern. These factors reduce the reproductive potential of the population.

Good quality freshwater habitat must be maintained if coho populations are to rebuild. We need to assemble and analyse a more complete dataset examining changes in fish size, fecundity, sex ratios, and ages. Information on juvenile life history patterns also needs to be assembled and analysed.

We have little control over negative random and naturally occurring events, but we can reduce fishing mortality on these fish. Our analysis unfortunately did not show many opportunities to have coho fisheries that would avoid harvesting Thompson origin fish,

other than north of Vancouver Island where Thompson fish are only occasionally found. One opportunity does exist in the mainstem Fraser; coho fisheries operating after the end of October will probably harvest very few Thompson coho; similarly, fisheries operating before mid-August will encounter few Thompson coho.

If future years are similar to 1997 with most coho residing outside the Strait of Georgia, and no commercial fishery on the West coast of Vancouver Island, we can anticipate a relatively high exploitation of Fraser/Thompson coho in Washington fisheries. Fishery managers need to be aware of the potential effects of American fisheries on Thompson/upper Fraser coho stocks. Unmonitored fisheries and incidental mortality in fisheries releasing coho are also a concern.

8. ACKNOWLEDGMENTS

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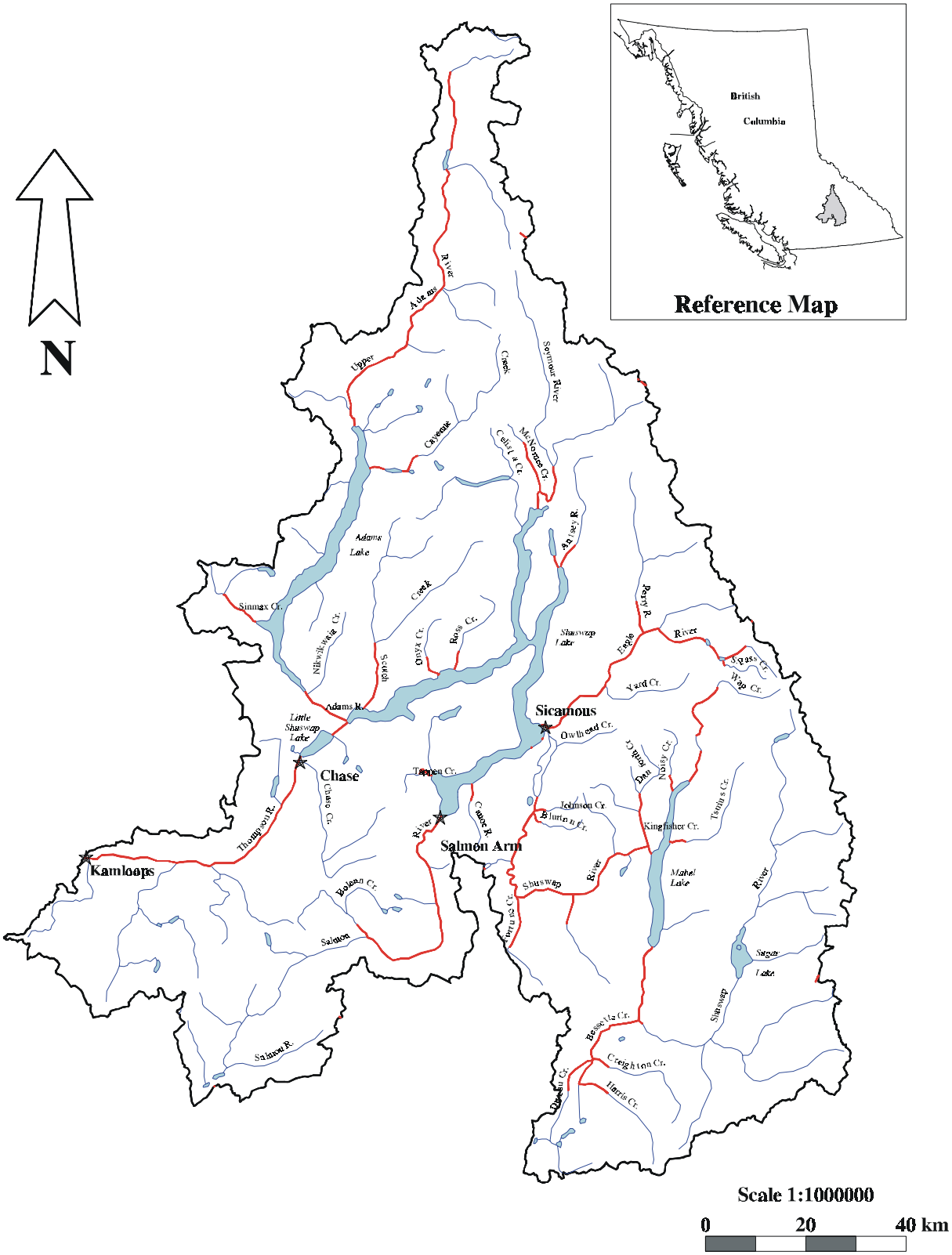


Figure 1.1 Coho spawning streams in the South Thompson-Shuswap

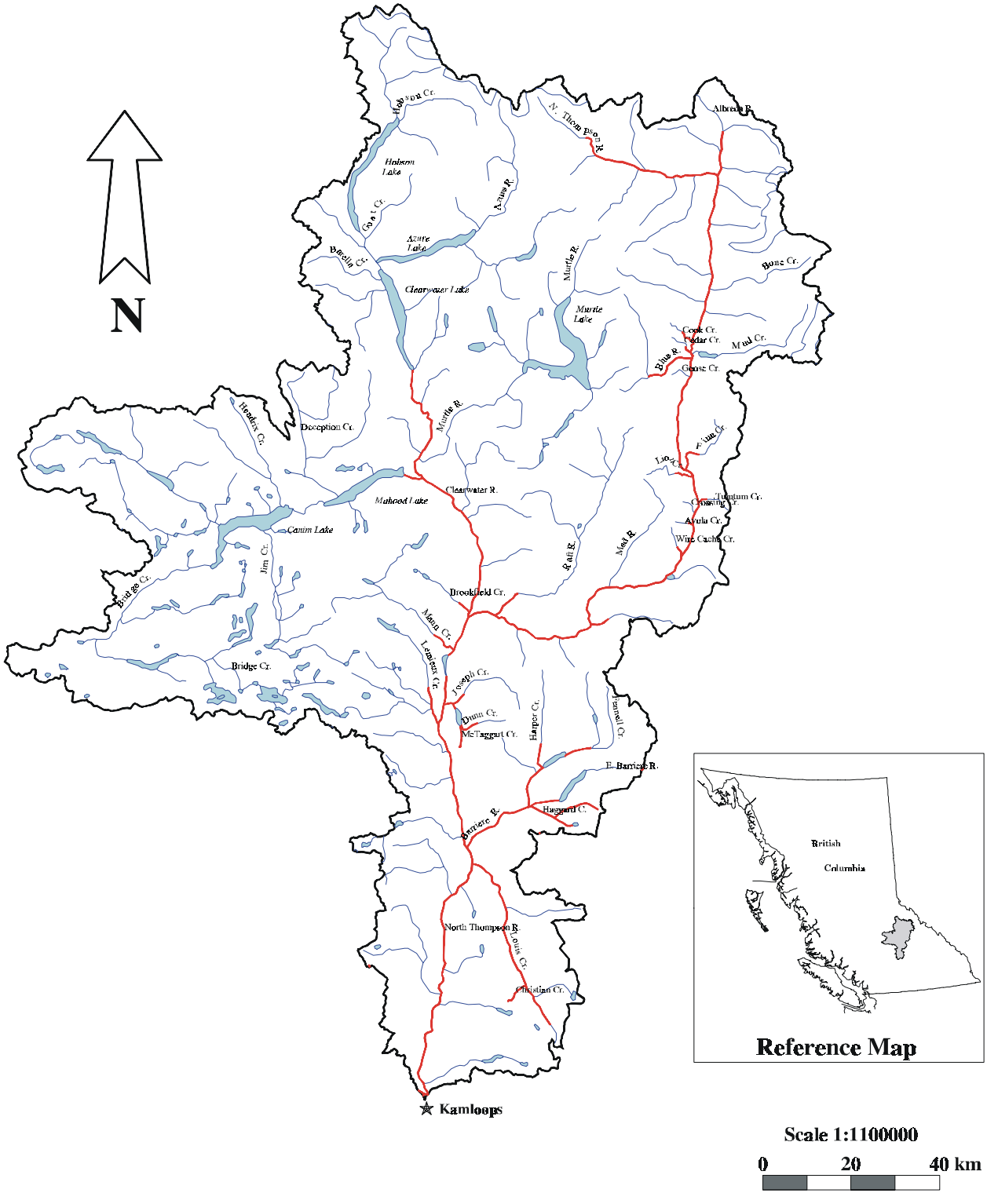


Figure 1.2 Coho spawning streams in the North Thompson

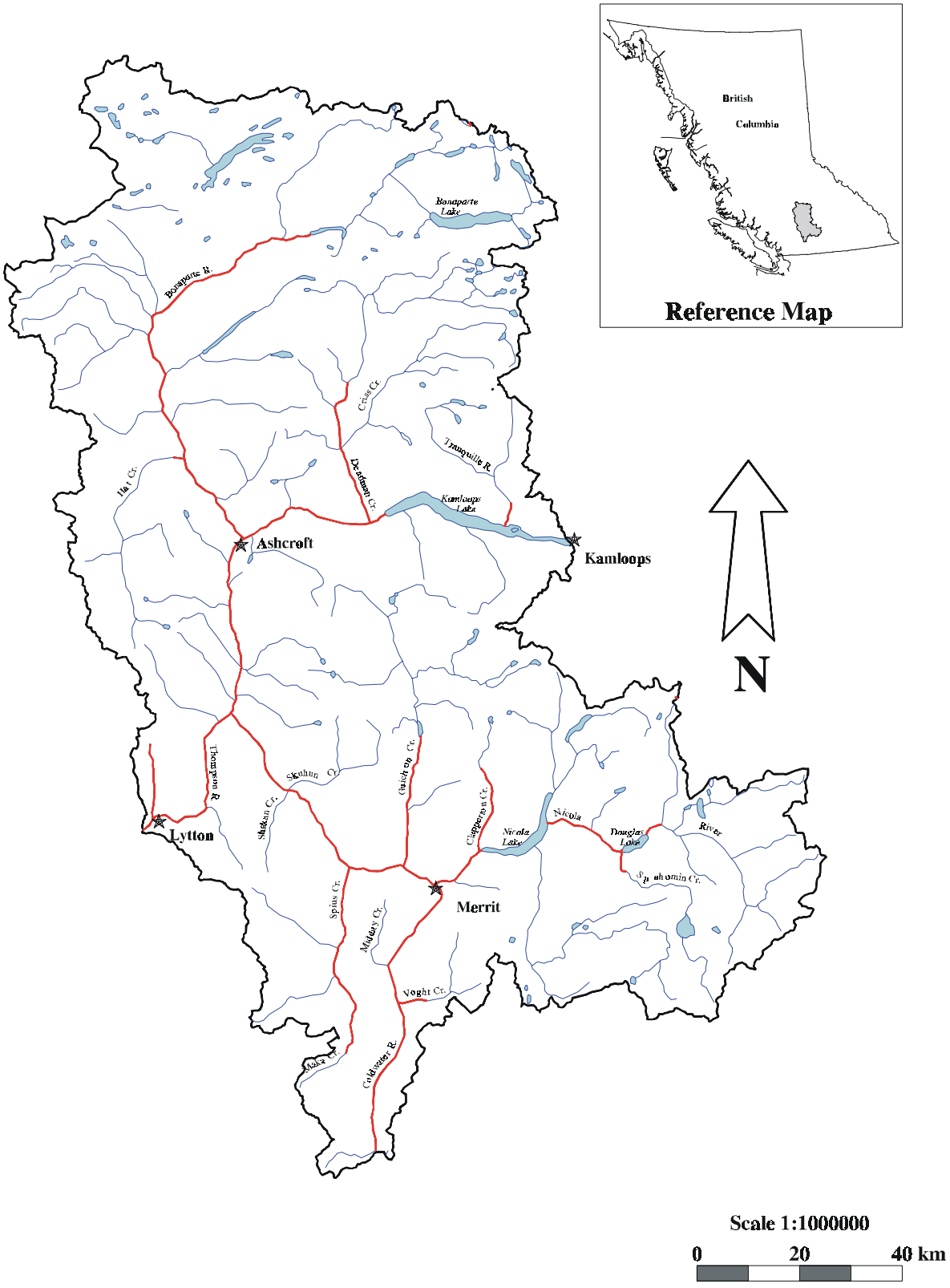


Figure 1.3 Coho spawning streams in the Lower Thompson/Upper Fraser

Figure 3.1 Aggregate Coho Escapement to 19 Streams in the South Thompson (trendline is a 3yr moving average)

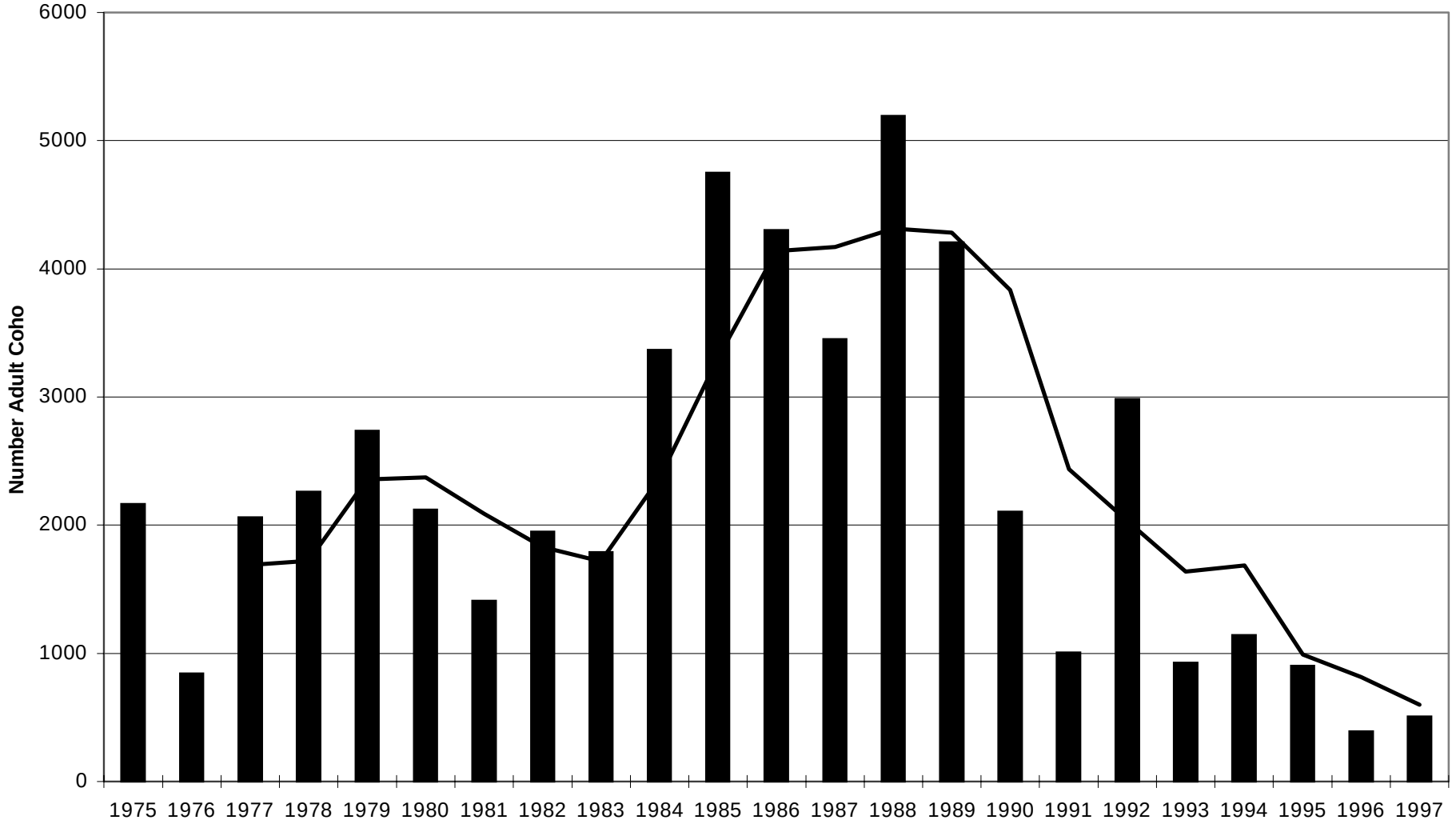


Figure 3.2 Index of Coho Escapements to 19 Streams in the South Thompson (trendline is a 3yr moving average)

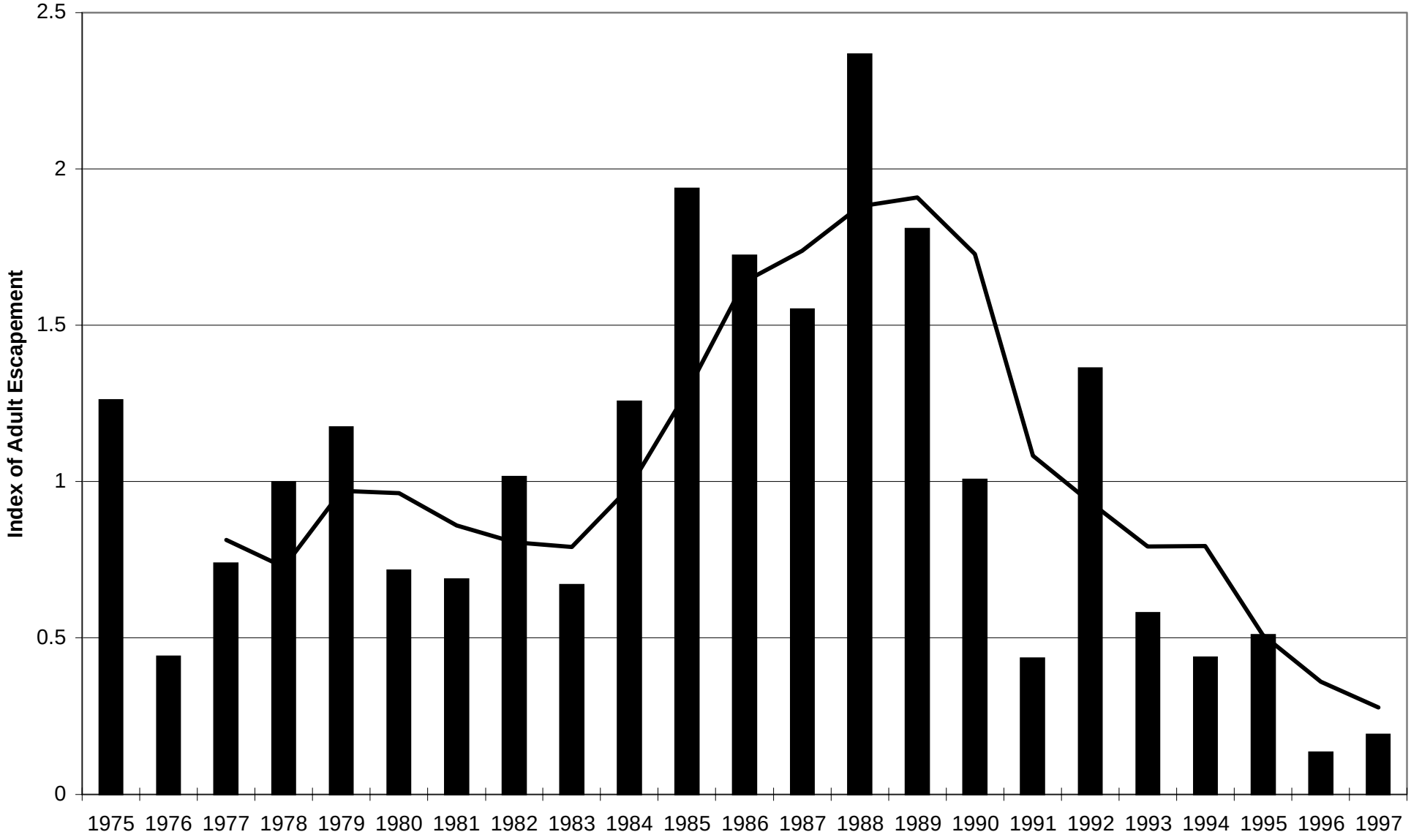


Figure 3.3. Aggregate Coho Escapement to 5 Streams in the South Thompson (trendline is a 3yr moving average)

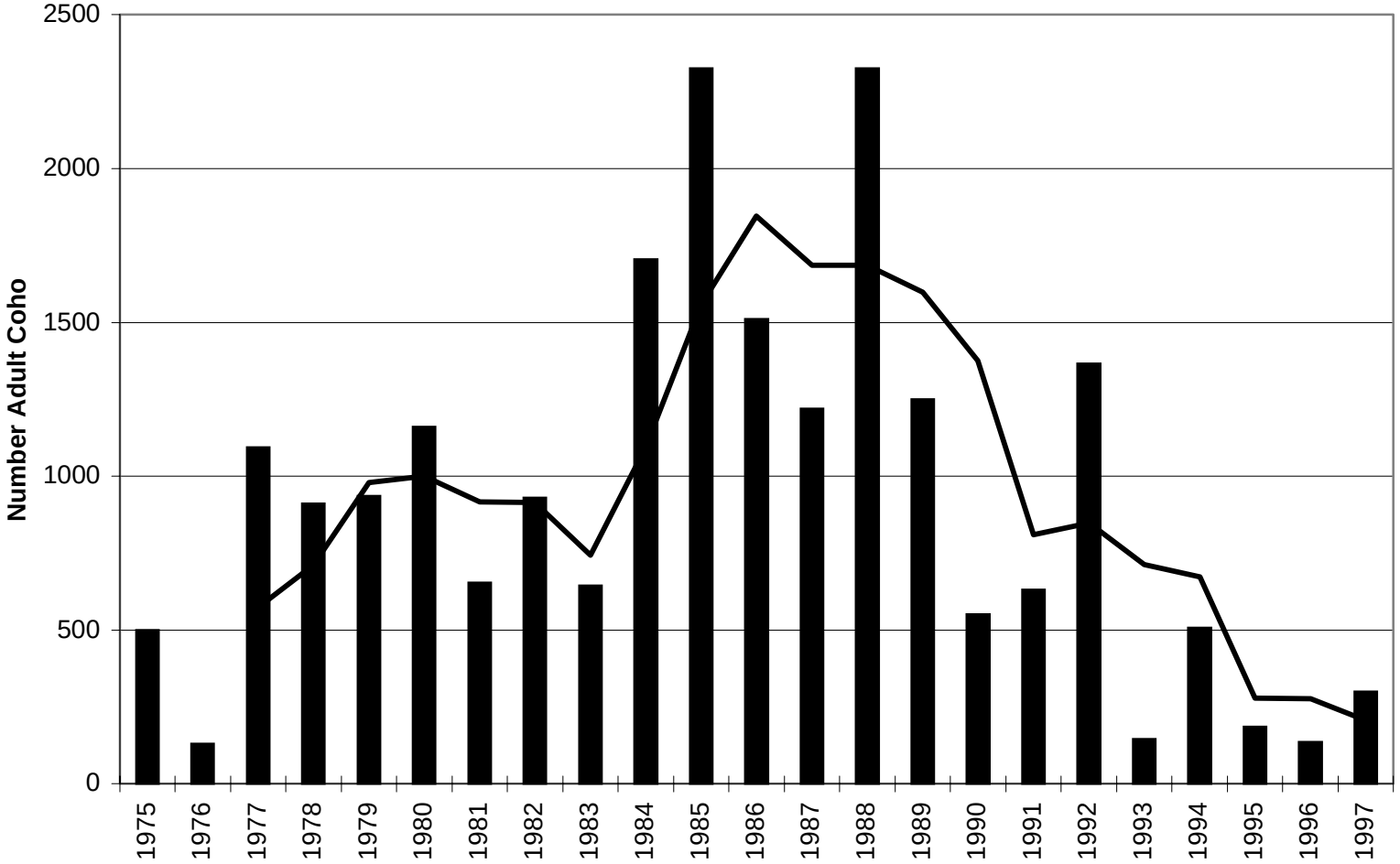


Figure 3.4. Index of Coho Escapements to 5 Streams in South Thompson (trendline is a 3yr moving average)

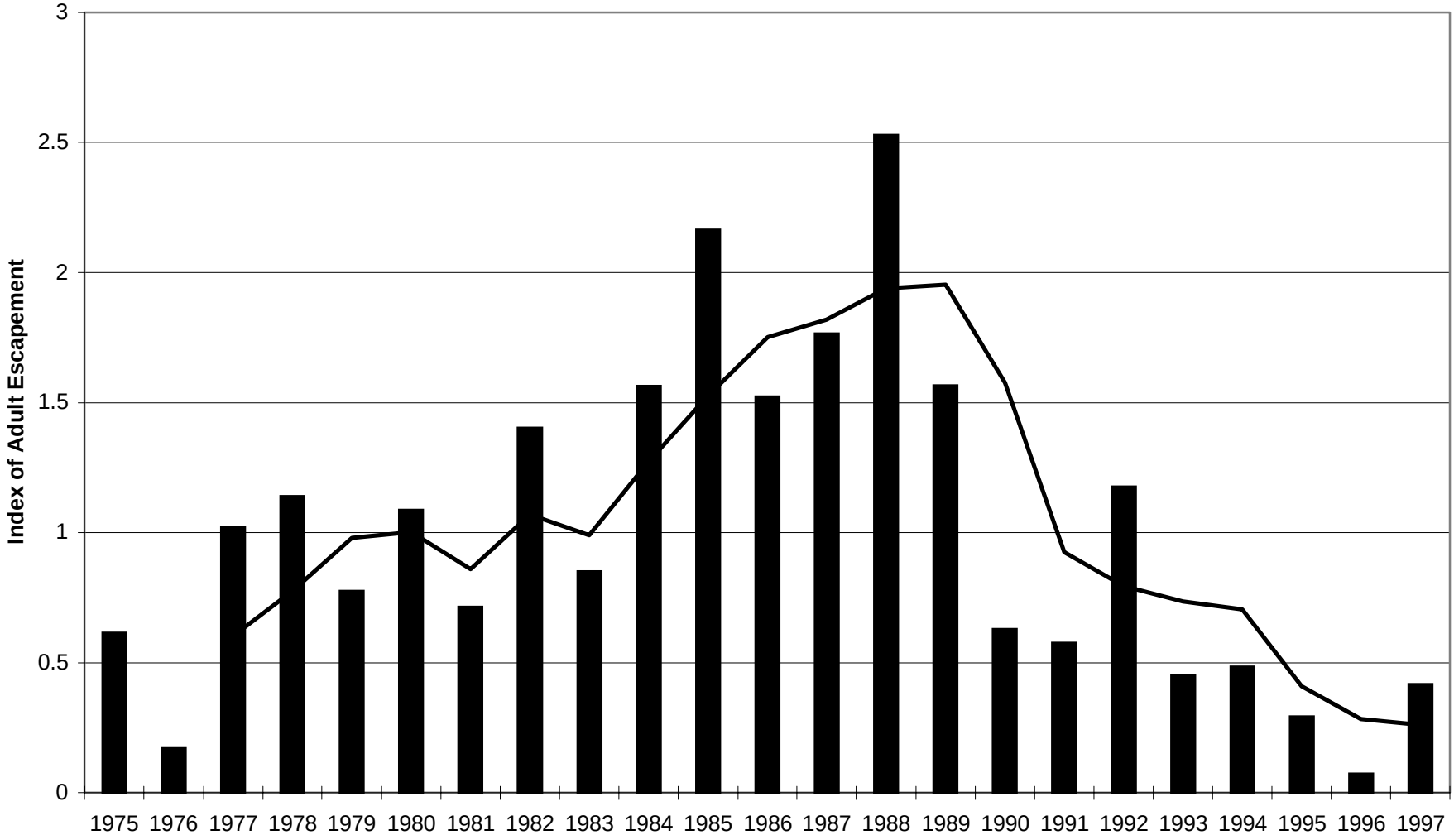


Figure 3.5 Index of Coho Escapements to 2 Enhanced Rivers in the South Thompson (trendline is 3yr moving average)

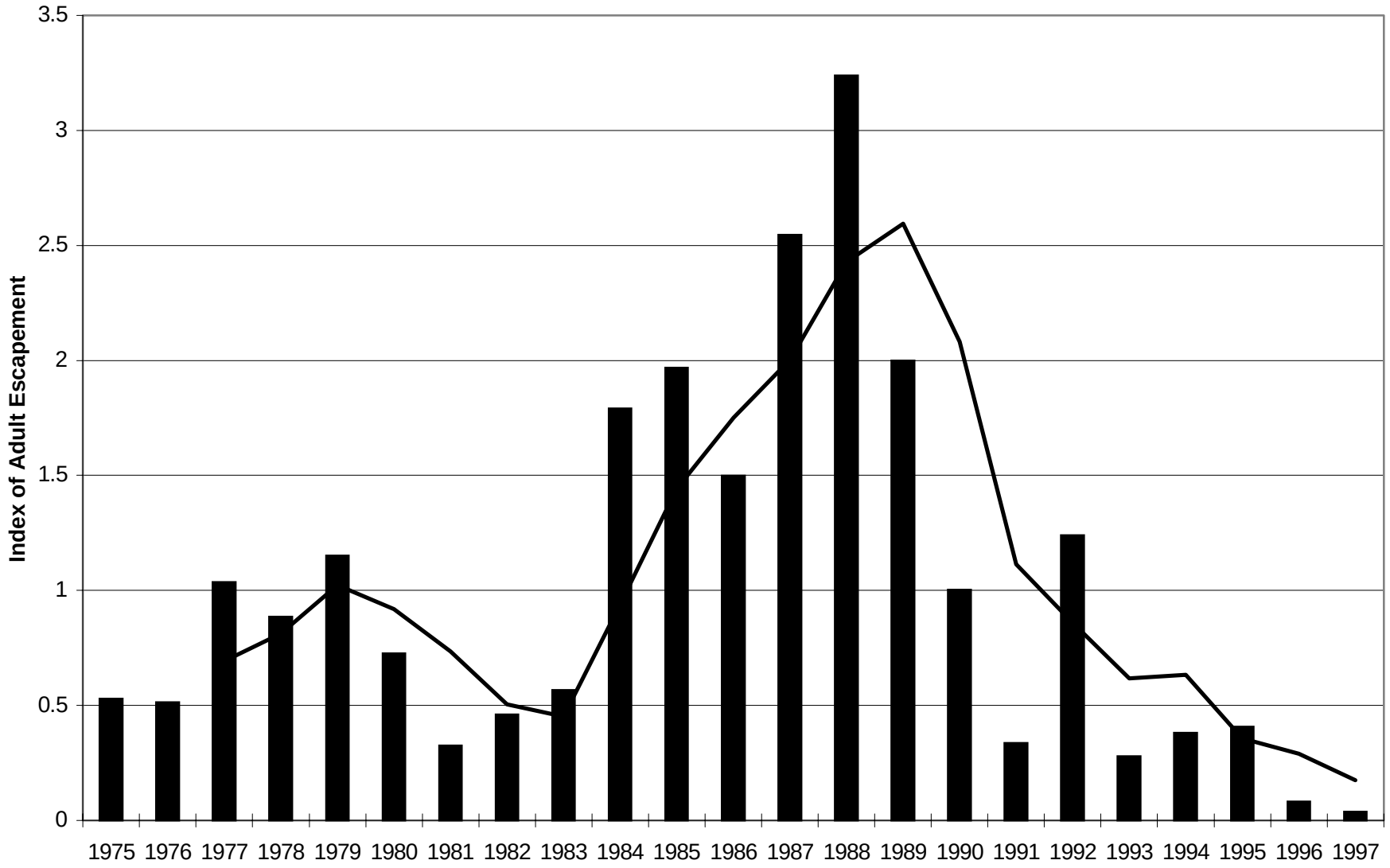


Figure 3.6 Proportion of South Thompson Streams Inspected with No Adult Coho Observed (numbers of streams inspected each year indicated; trendline is a 3yr moving average)

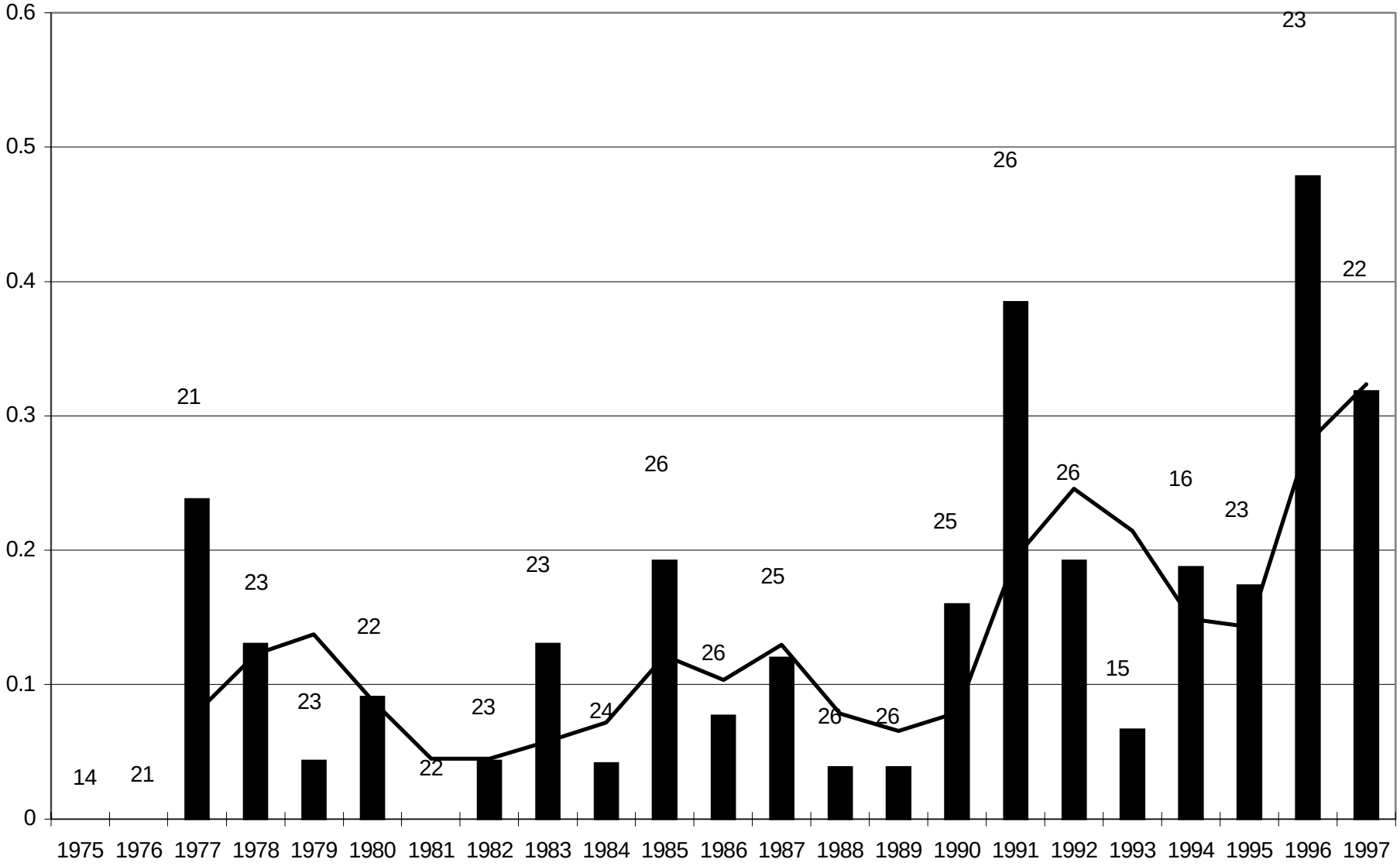


Figure 3.7 Aggregate Coho Escapement to 10 North Thompson Streams (trendline is a 3yr moving average)

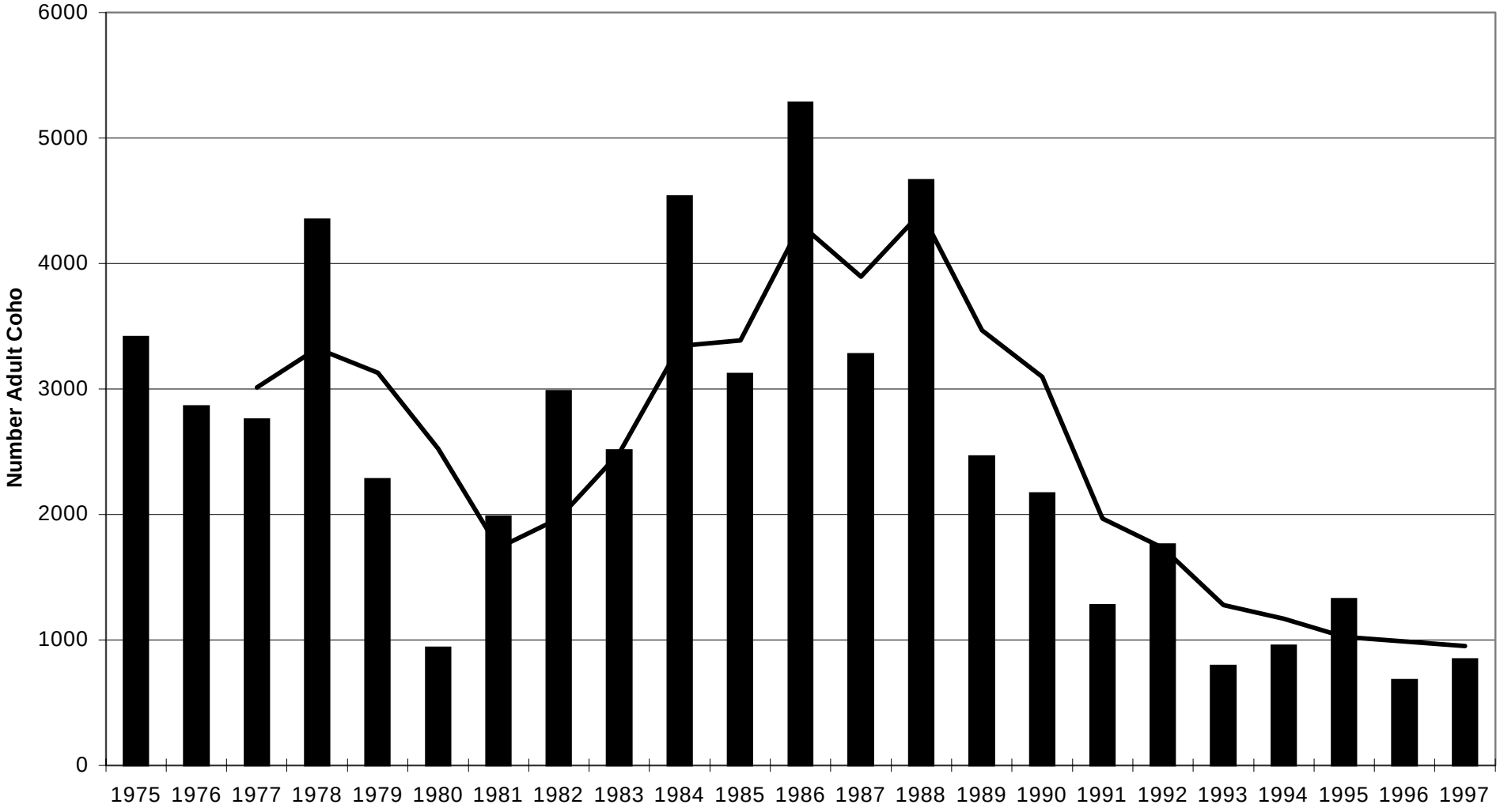


Figure 3.8 Index of Coho Escapements to 10 North Thompson Streams (trendline is a 3yr moving average)

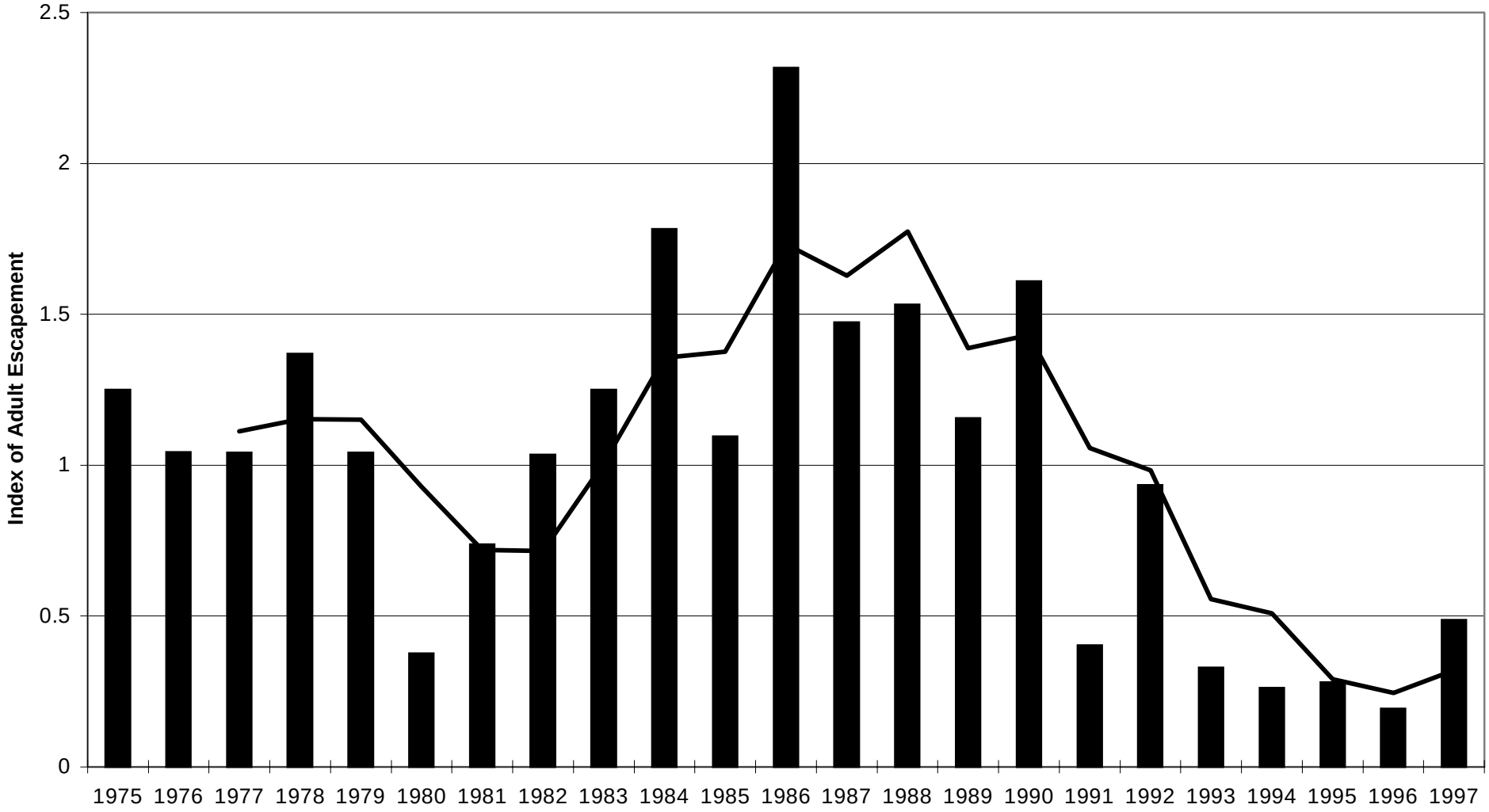


Figure 3.9 Index of Coho Escapements to Three Enhanced Streams in the North Thompson (trendline is a 3yr moving average)

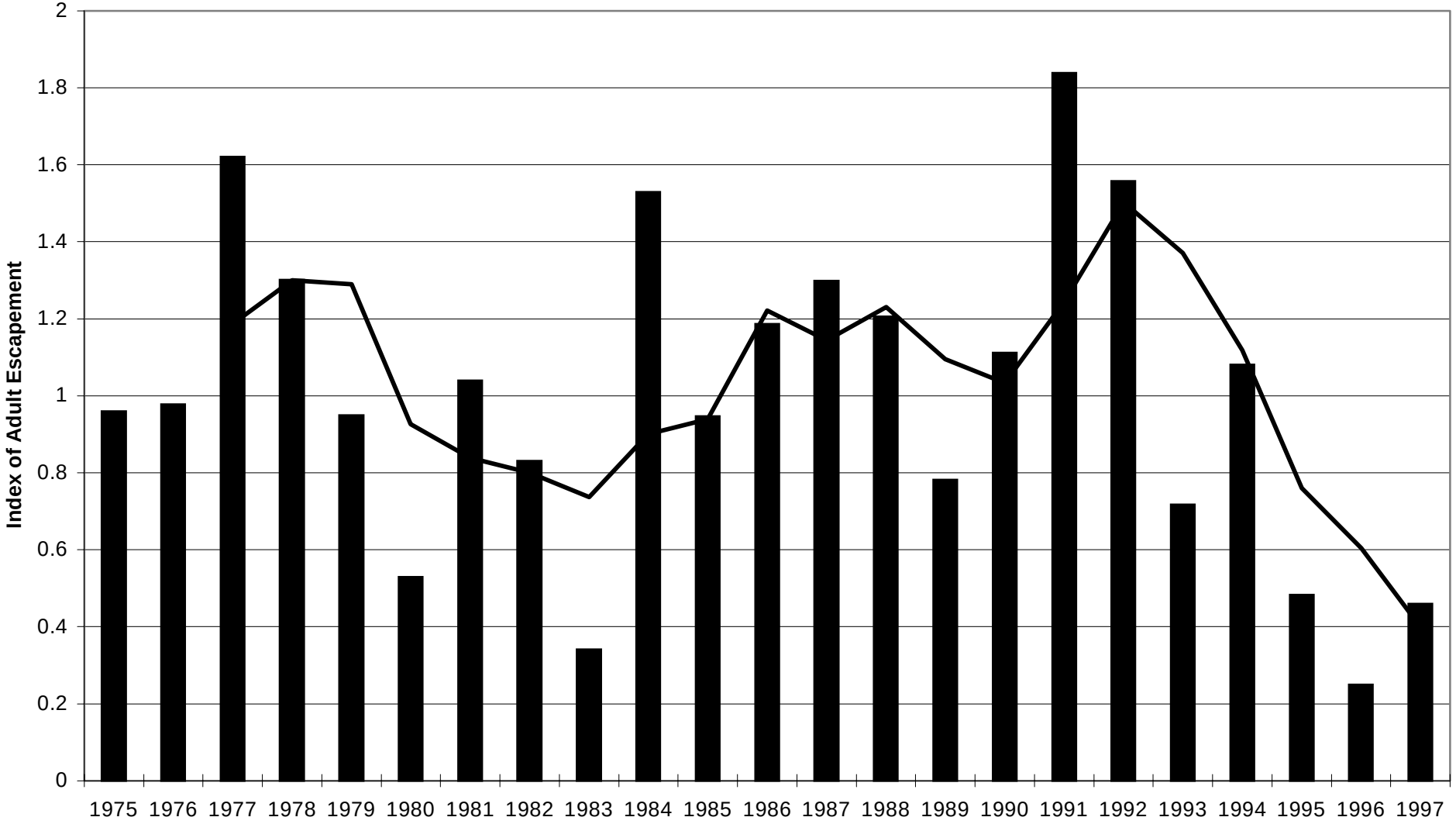


Figure 3-10 Proportion of North Thompson Streams Inspected with no Adult Coho Observed (numbers of streams inspected each year indicated; trendline is a 3yr moving average)

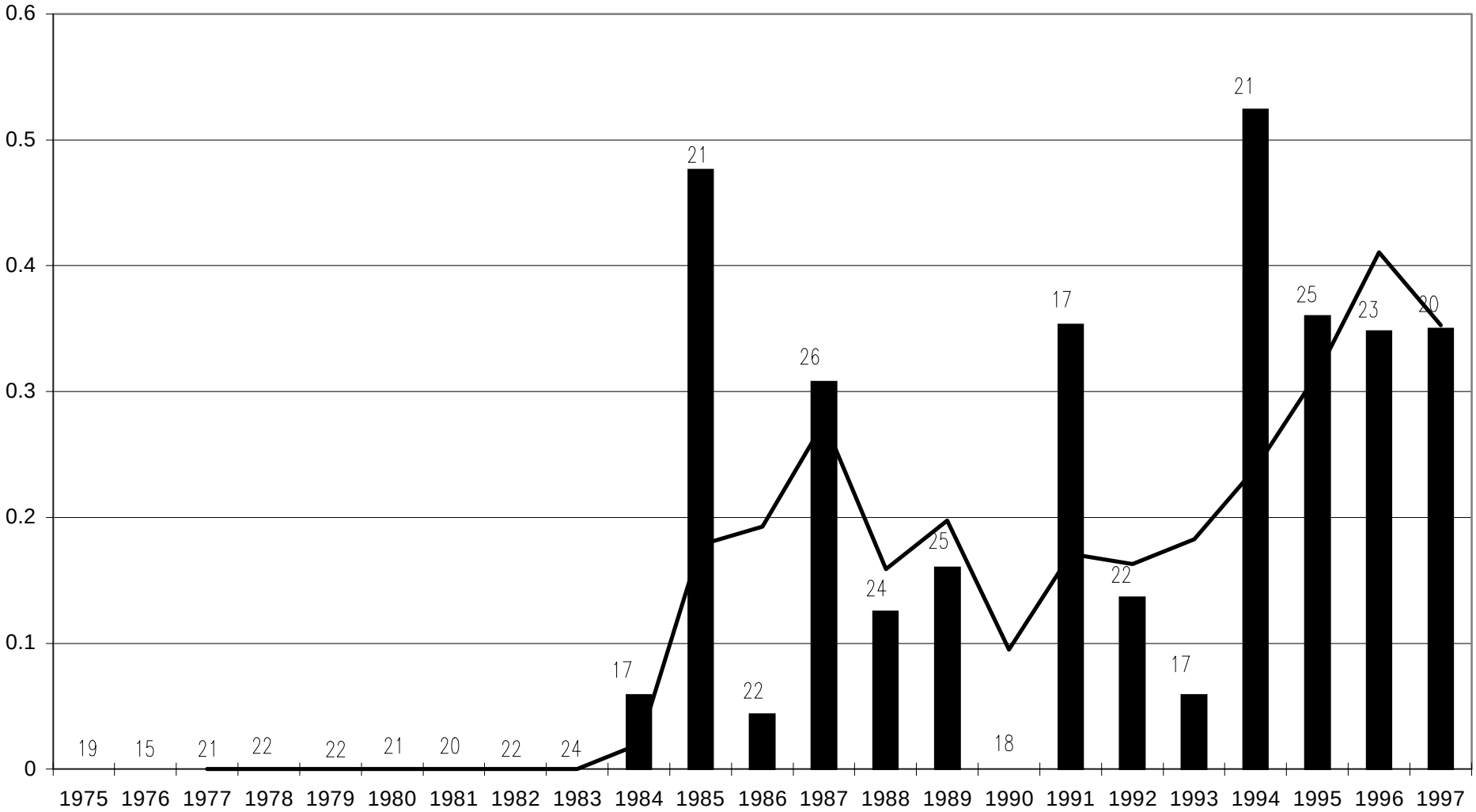


Figure 3.11 Aggregate Coho Escapements to 4 Streams in the Lower Thompson (trendline is a 3yr moving average)

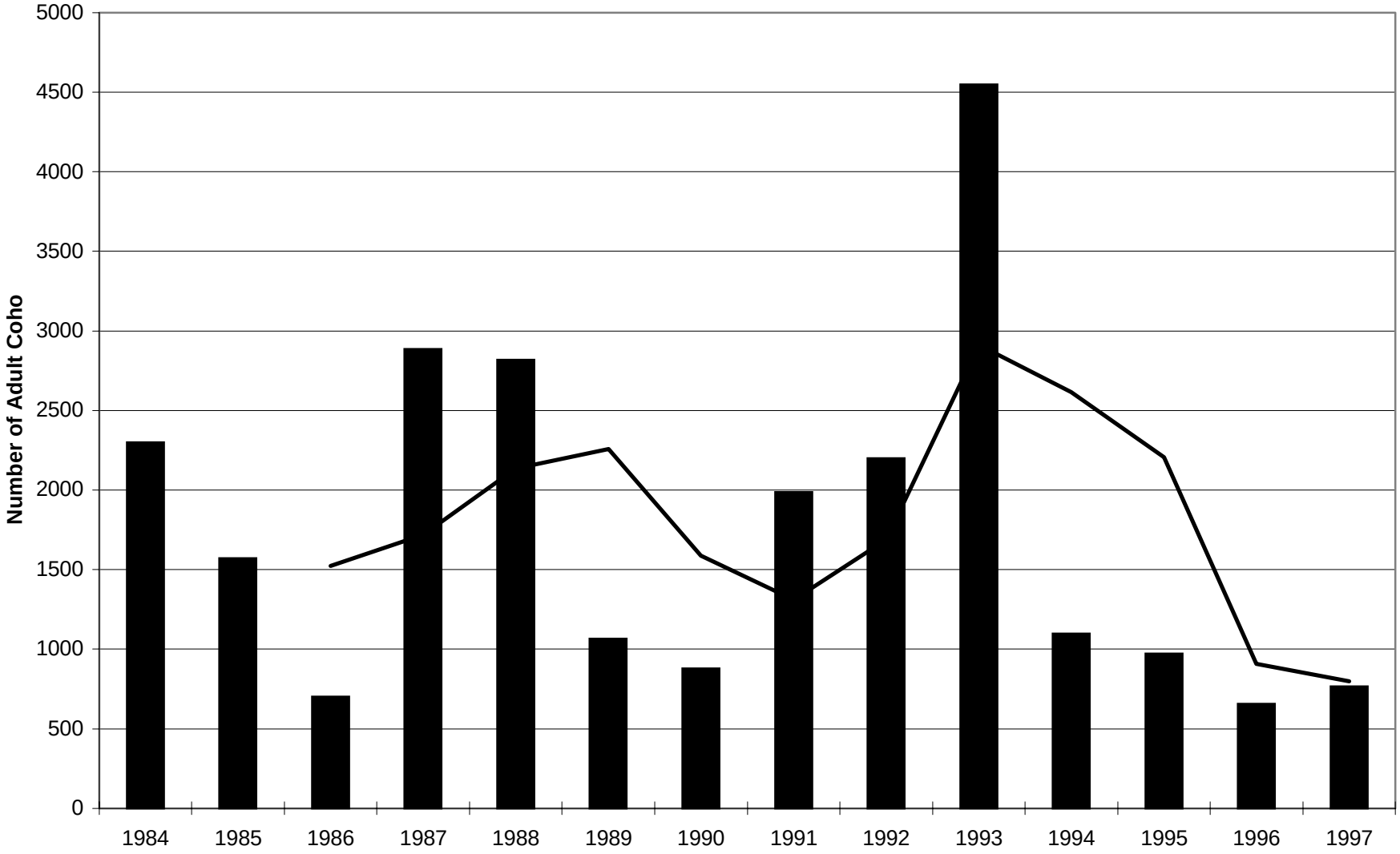
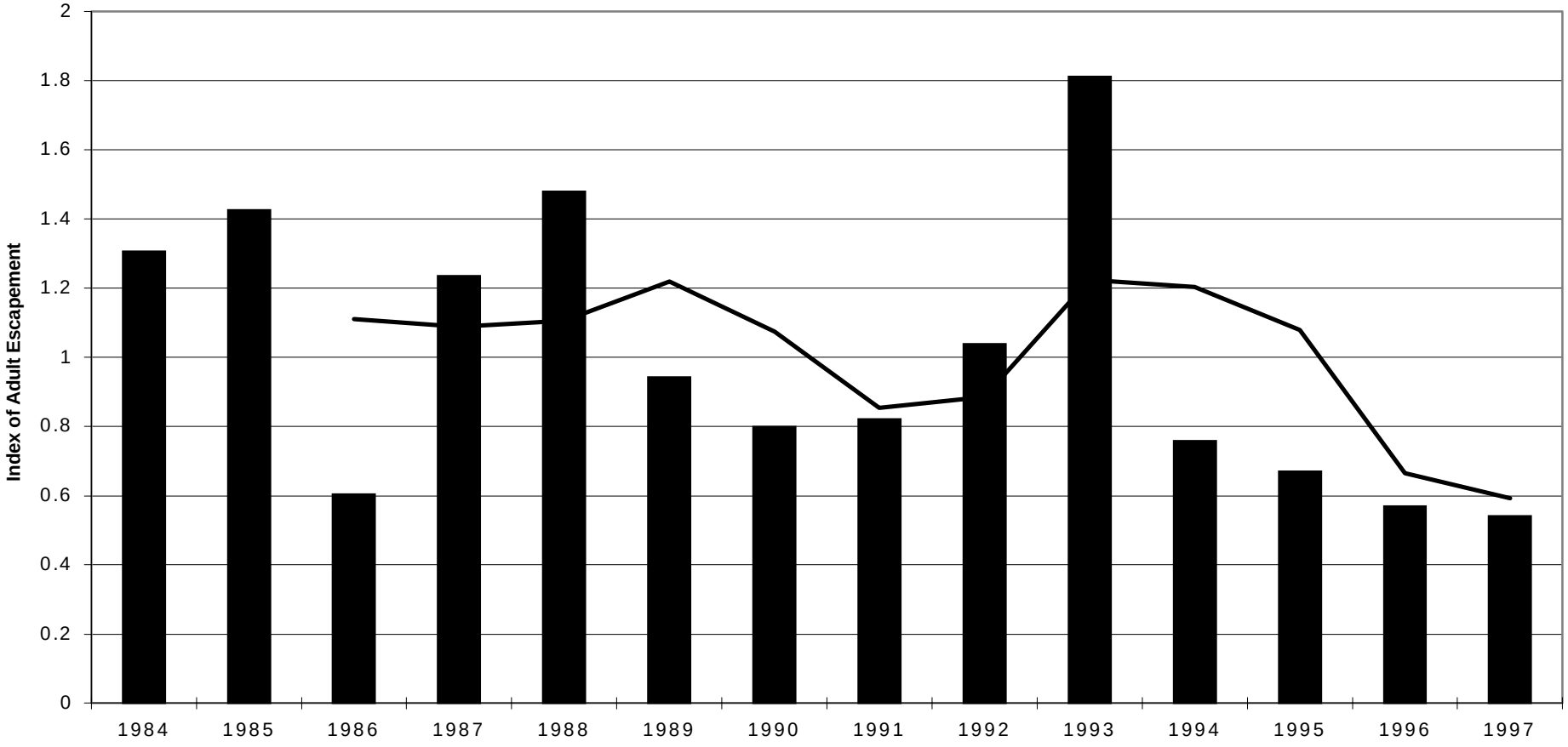


Figure 3.12 Index of Coho Escapement to 4 Lower Thompson/Upper Fraser Streams (trendline is a 3yr moving average)



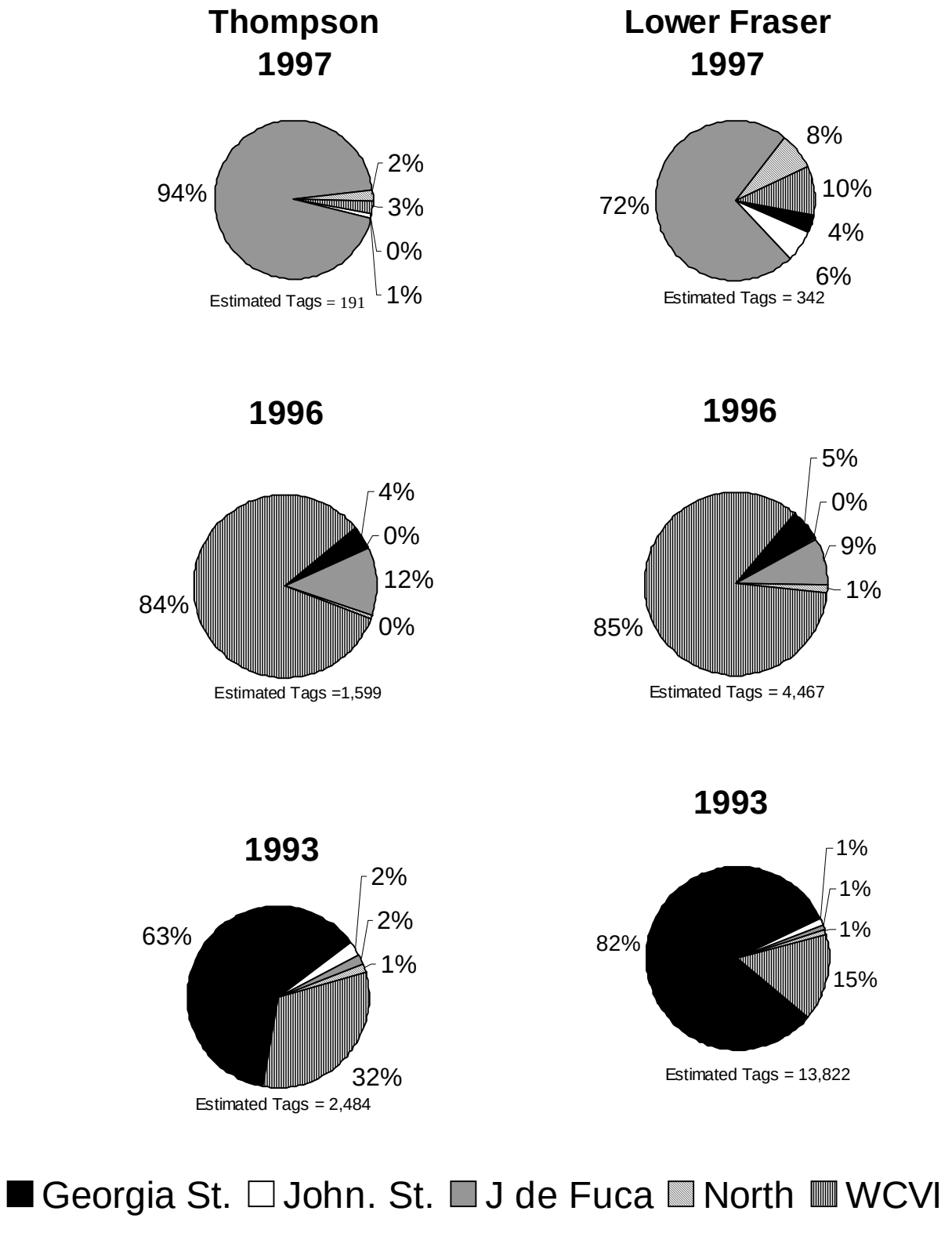


Figure 5-1 Percent of estimated marine catch of Coded Wire Tagged Thompson and Fraser River coho harvested in major Canadian fisheries with total estimated tag recoveries in each group. 'North' includes all fisheries north of Johnstone Strait and NWVI Troll

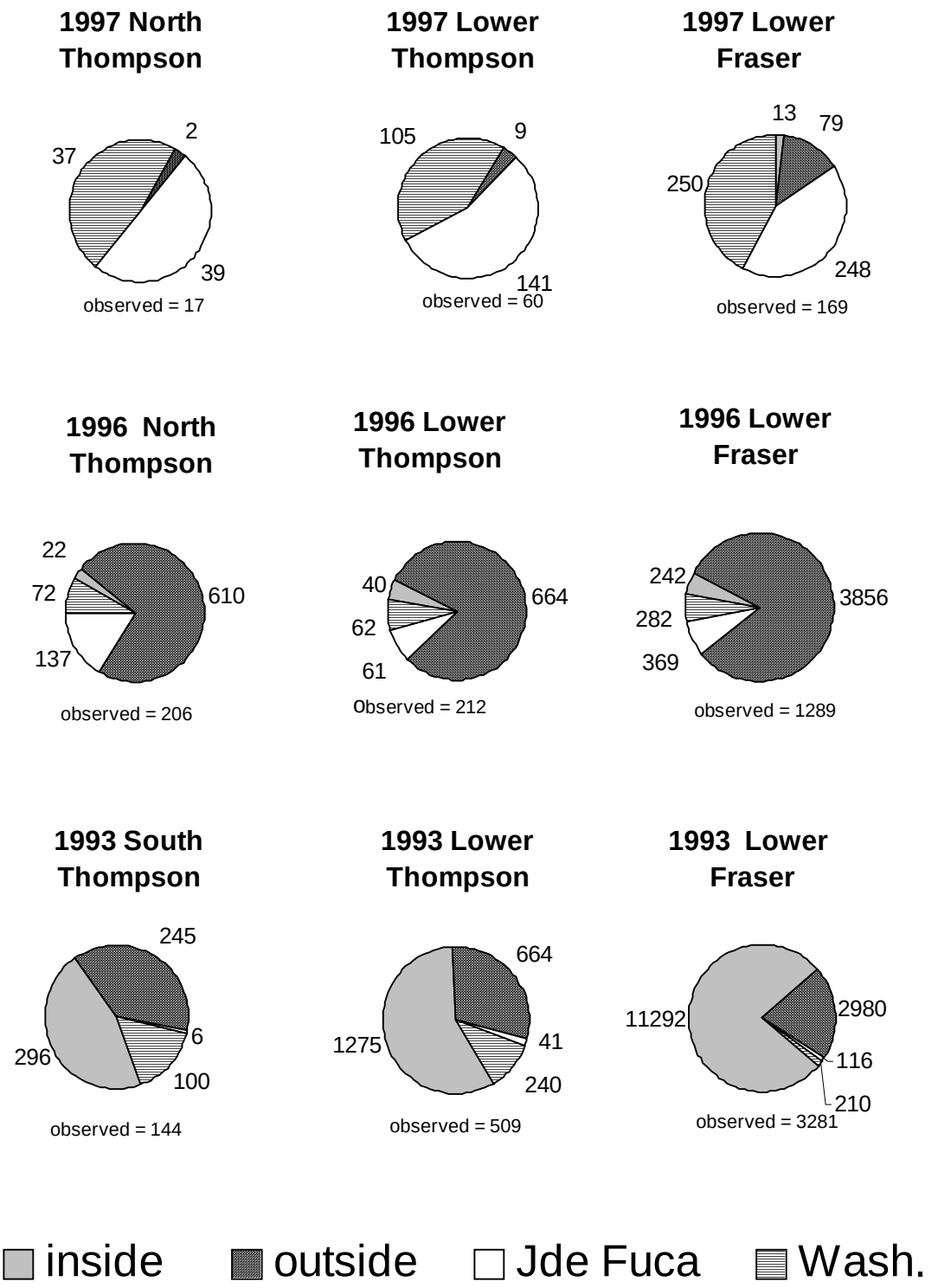


Figure 5-2 Estimated marine catch of Coded Wire Tagged Thompson and Fraser River coho salmon from fisheries inside and outside of Georgia Strait, in Juan de Fuca and Washington State with total observed recoveries from the same fisheries

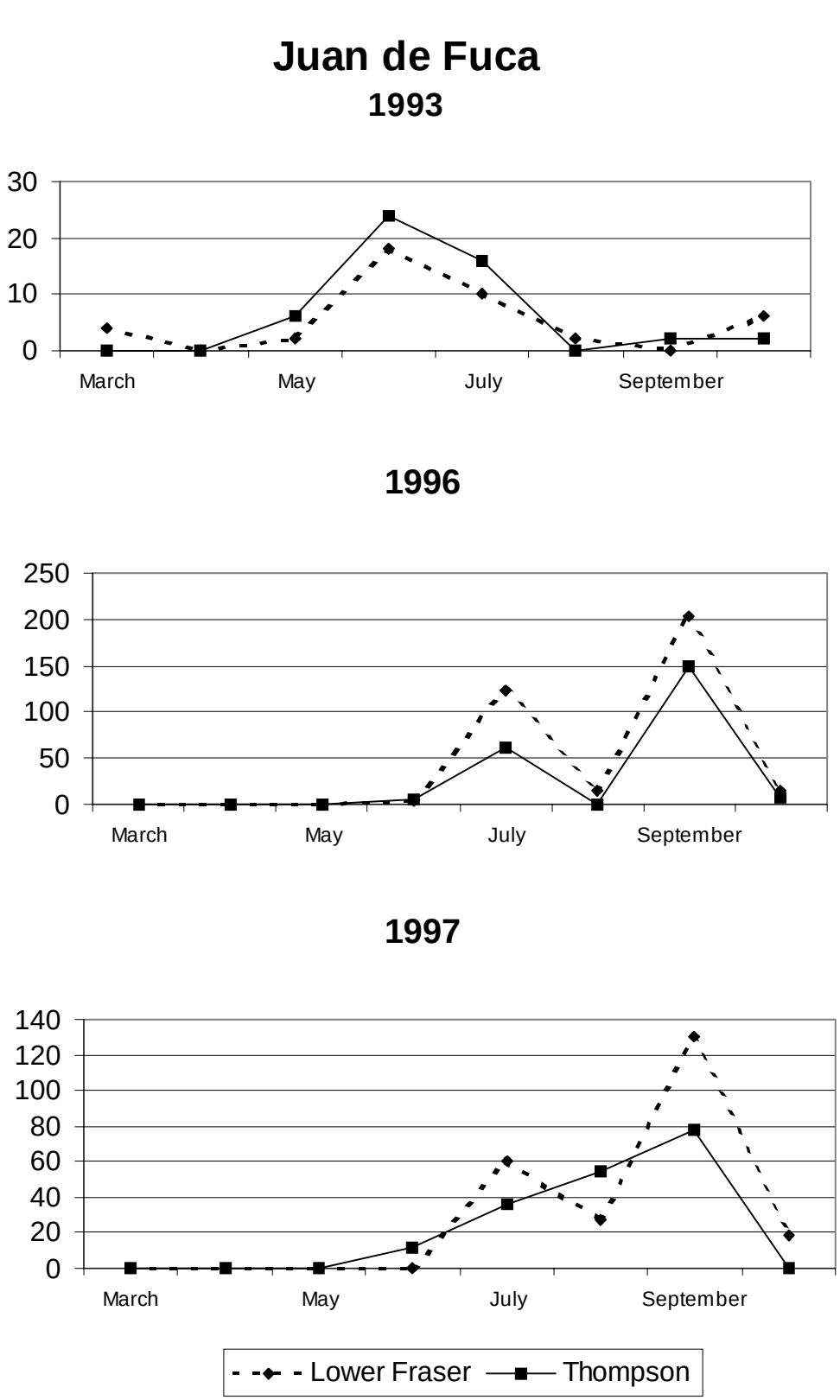


Fig 5-3 Estimated recoveries of Coded Wire Tagged Lower Fraser and Thompson Coho in the Juan de Fuca sport Fishery

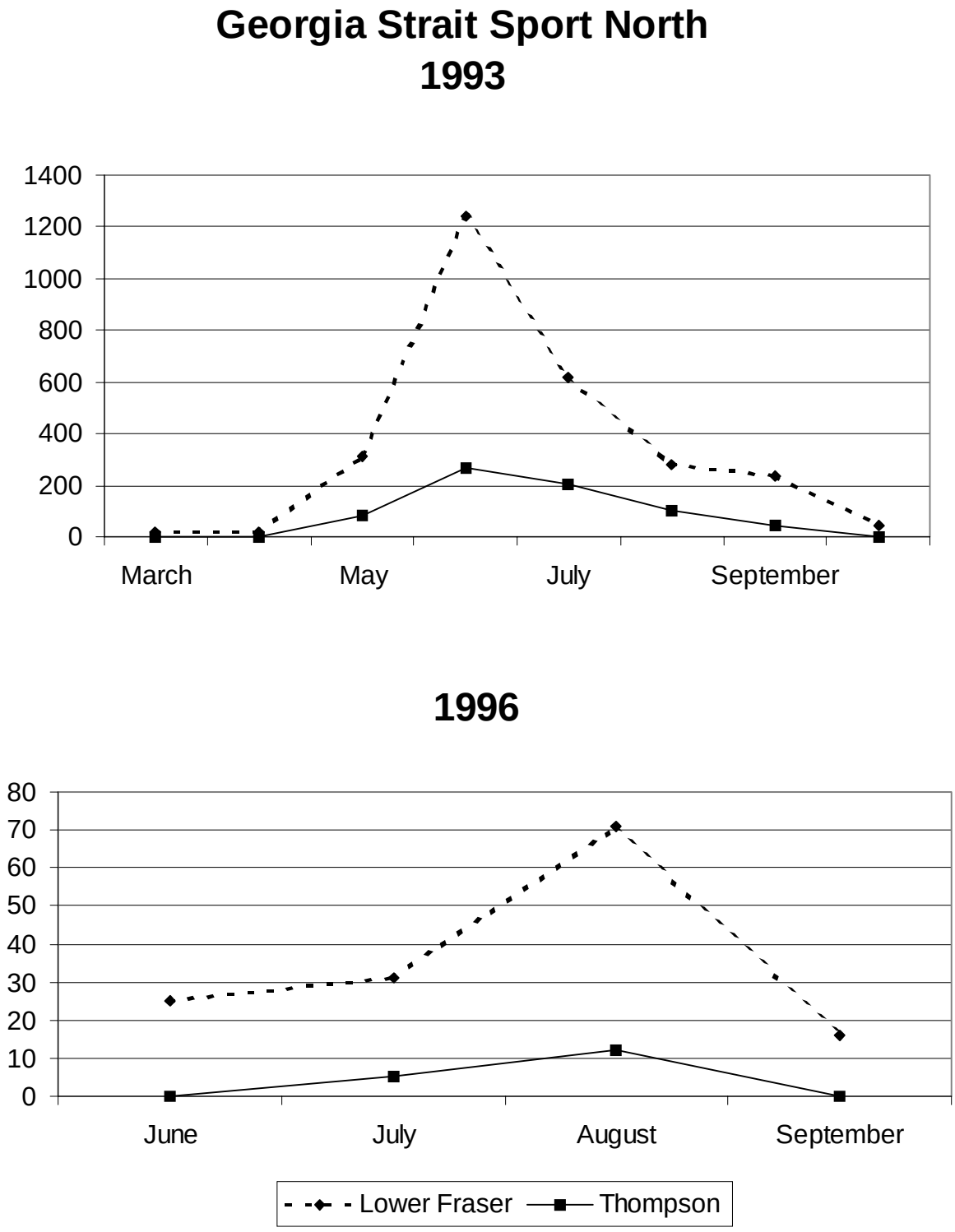


Figure 5-4 Estimated recoveries of Coded Wire Tagged Lower Fraser and Thompson Coho in the Sport fishery in Northern Georgia Strait

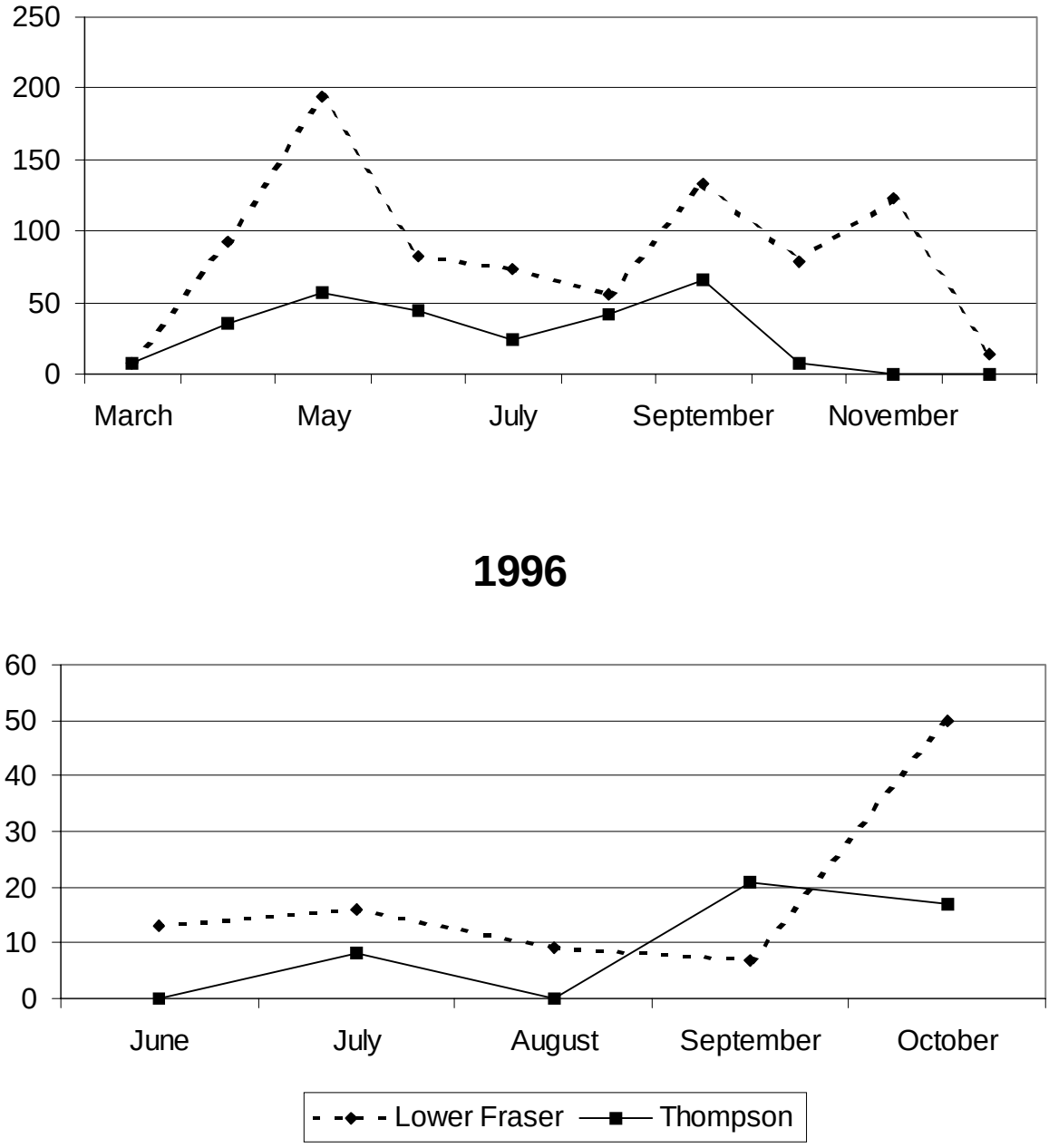


Figure 5-5 Estimated recoveries of Coded Wire Tagged Lower Fraser and Thompson Coho in the Sport fishery in Southern Georgia Strait

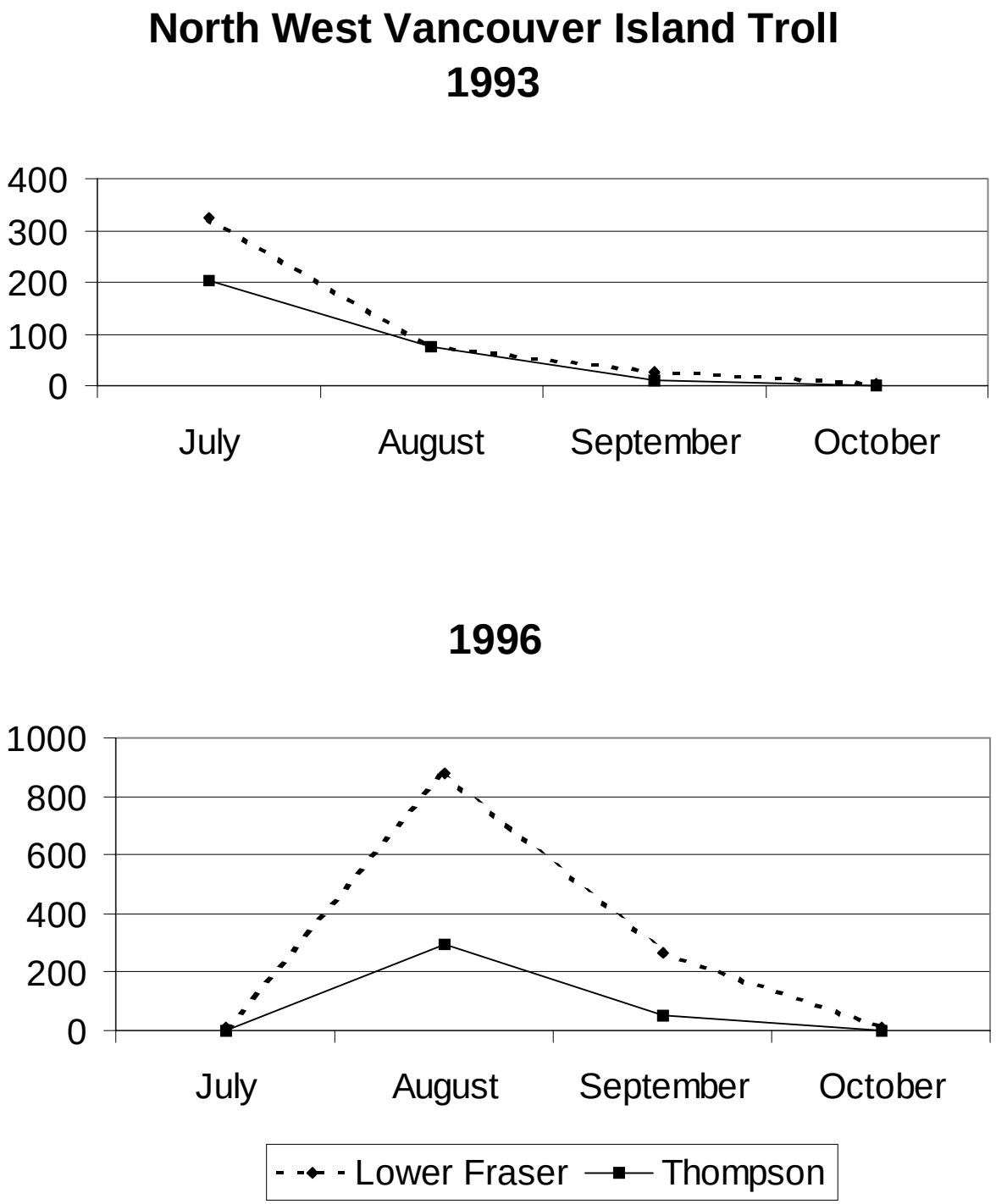


Figure 5-6 Estimated recoveries of Coded Wire Tagged Lower Fraser and Thompson Coho in the North West Vancouver Island Troll fishery

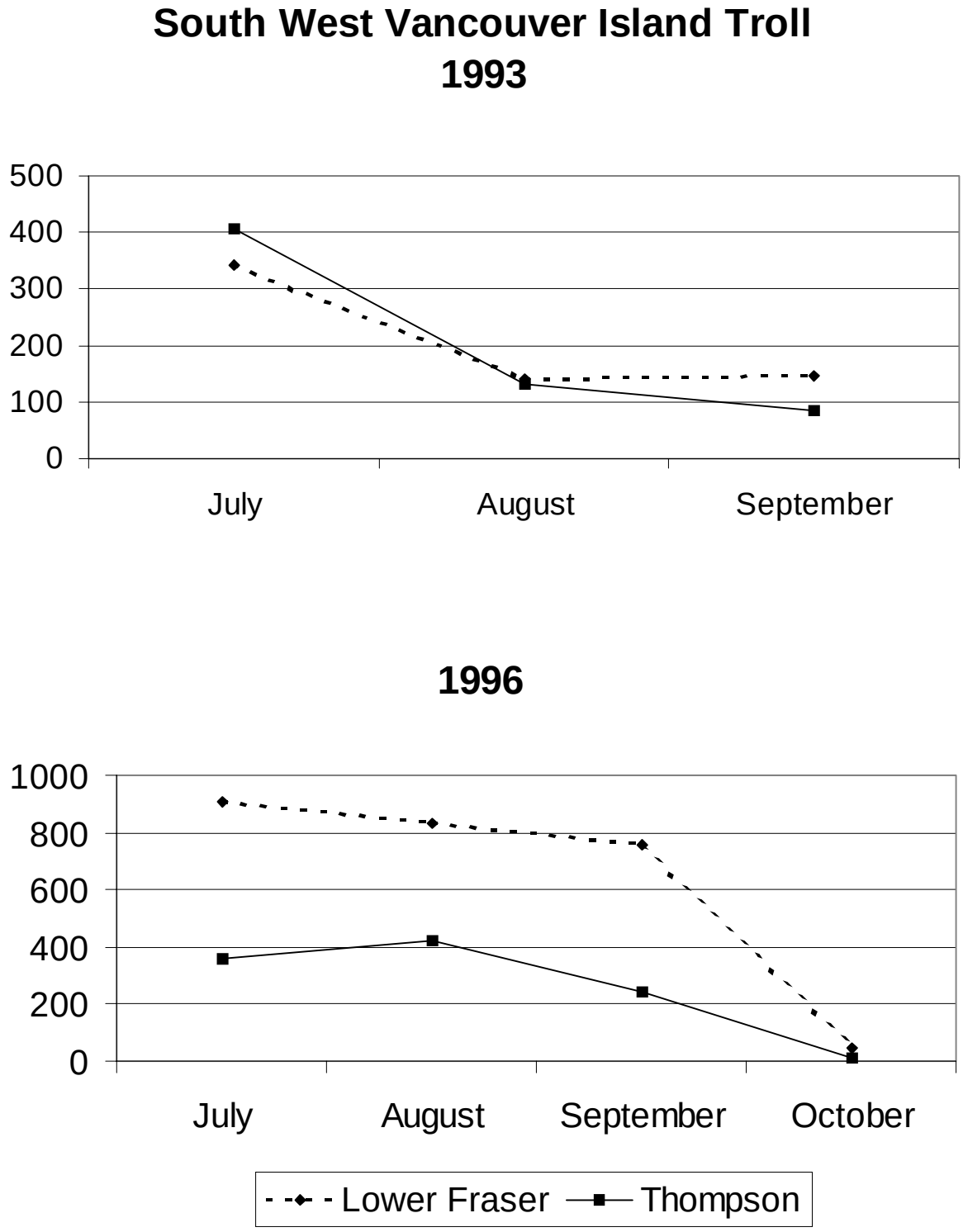


Figure 5-7 Estimated recoveries of Coded Wire Tagged Lower Fraser and Thompson Coho in the South West Vancouver Island Troll fishery

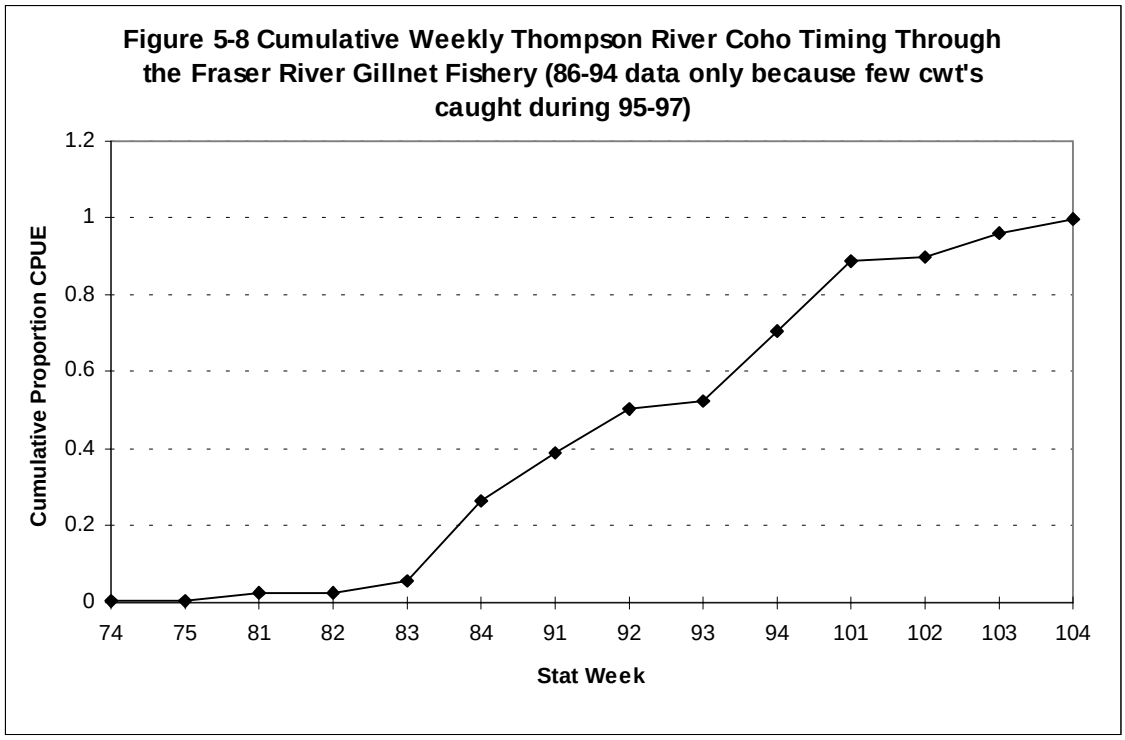


Figure 5-8 Cumulative Weekly Thompson River Coho Timing Through the Fraser River Gillnet Fishery (86-94 data only because few cwt's caught during 95-97)
Cumulative Proportion CPUE
1.2
1
0.8
0.6
0.4
0.2
0
74
75
81
82
83
84
91
92
93
94
101
102
103
104
Stat Week

Figure 6.1 Mean Total Fishery Exploitation Rates for Thompson Coho

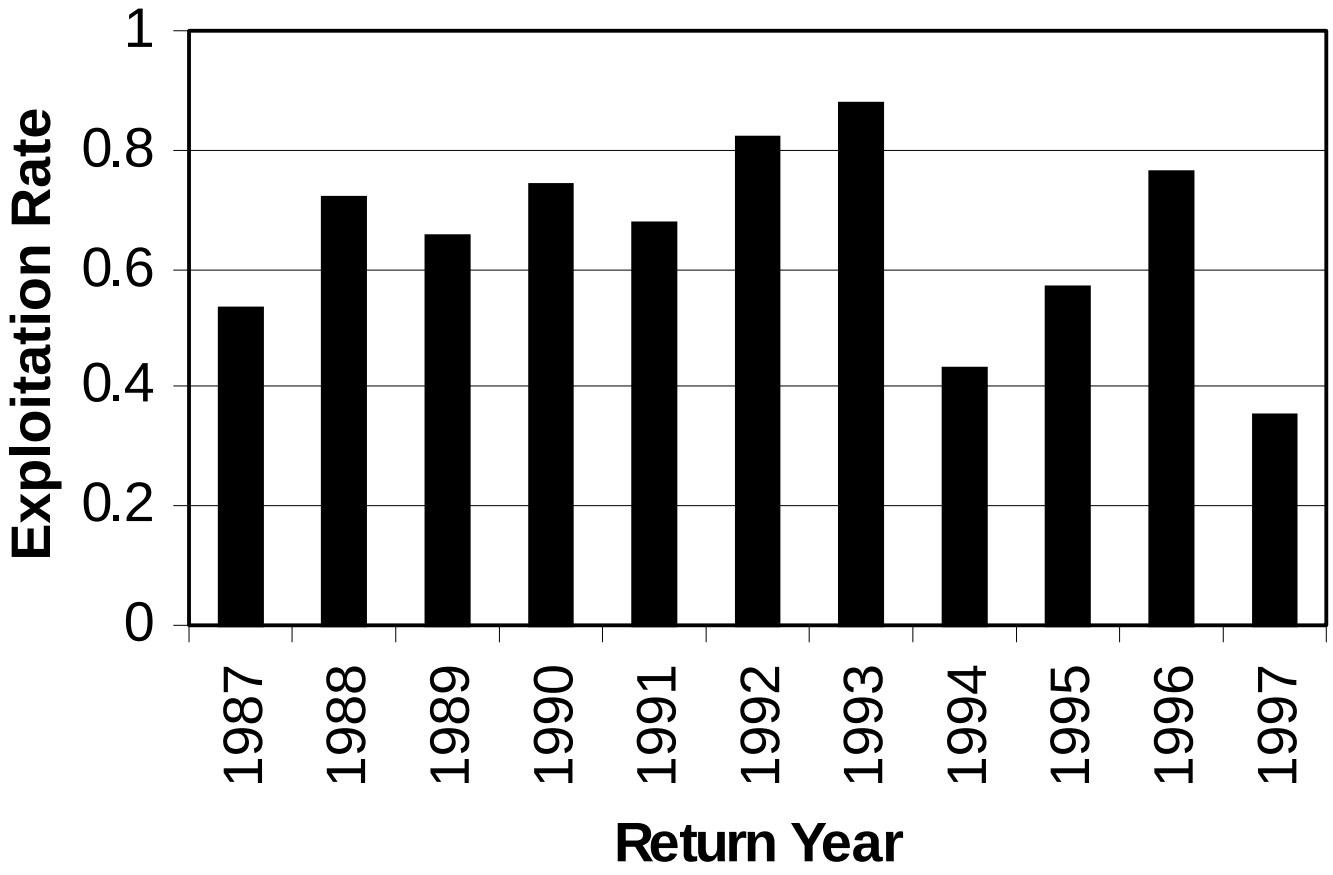


Table 2.1 Overview of fry and smolt releases in Thompson streams[1].

System	Mean annual fry release	Mean 1990's fry release	Most common release season*	No.of yrs of fry releases	Mean annual smolt release	Mean 1990's smolt release	No.of yrs of smolt releases
Dunn	47,804	24,377	Fall	13 (to '95)	18,127	19,105	10 (since '88)
Eagle	456,839	412,548	Spring	11 ('84-'94)	45,810	60,566	6 ('86-'91)
Lemieux	20,436	10,037	Spring	15	18,169	18,169	8 (since '90)
Louis	24,411	13,092	Spring	16 (to '95)	14,419	16,479	8 (since '90)
Salmon	203,420	146,742	Spring	17	15,322	15,322	2 ('93 and '94 only)
Coldwater	233,170	177,828	Spring	12 (85-96)	89,967	57,497	11 (since '87)
Spius	69,834	54,970	Spring	11 (87-97)	133,081	133,081	3 (since '95)

[1] Each release site has many examples of spring, summer & fall plants except Salmon, where all but one release was in spring.

Means were calculated from the first release year for either fry or smolts to 1997 release year, unless indicated otherwise.

Table 3.1. Annual (r_{an}) and finite rates of change (per year = $1-e^{r_{an}}$; per generation = $1-e^{3r_{an}}$) for various Thompson coho stock aggregates.

				Finite Rate of Change					
	1975-1988	1988-1997	1975-1997	1975-1988	1988-1997	1975-1997	1975-1988	1988-1997	1975-1997
Stock Aggregate	Annual	Annual	Annual	Per Year	Per Year	Per Year	Per Gen.	Per Gen.	Per Gen.
South Thompson - 19 streams	0.09	-0.26	-0.04	0.09	-0.23	-0.04	0.30	-0.54	-0.11
North Thompson - 10 streams	0.03	-0.17	-0.05	0.04	-0.16	-0.05	0.11	-0.40	-0.15
Lower Thompson - 4 streams	NA	-0.09	NA	NA	-0.09	NA	NA	-0.25	NA

Table 3.2. Escapement statistics for Eagle River, South Thompson.

Return Year	Removed for Broodstock	Counted Through Fence	Estim. Uncounted Past Fence	Estim. Below Fence	Total Natural Spawners[1]	Total Escape. Estimate[2]	Comments
1997					150	150	Estimate prob. biased low-based on numbers counted during 2 float counts one month apart (41 live + dead)
1996		254			254	254	254 includes 13 identified as jacks.
1995		428	182	190	800	800	Below fence estimate obtained from the difference between the FO estimate and SEP estimates of natural spawners. 428 includes 14 identified as jacks.
1994		1485			1485	1485	1485 includes 47 identified as jacks.
1993	116	428		333	761	877	428 includes 1 identified as jack.
1992	320	2732		300	3032	3352	
1991	583	1342		20	1362	1945	1342 includes 2 identified as jacks.
1990	511	2095	1765	25	3885	4396	
1989	742	5014		100	5114	5856	No jacks noted.
1988	744	7808		1748	9556	10300	No jacks noted.
1987	431	9574		1010	10584	11015	9574 includes 9 identified as jacks.
1986	425	3789		286	4075	4500	3789 includes 23 identified as jacks.

[1]Numbers of natural spawners are the same as in our database (Appendix 1).
[2]These numbers are incomplete because numbers of fish harvested are not included.

Table 3.3. Escapement statistics for Salmon River, South Thompson.

Return Year	Removed for Broodstock	Counted Through Fence	Estim. Uncounted Past Fence	Estim. Below Fence	Total Natural Spawners[1]	Total Escape. Estimate[2]	Comments
1997	17	17			34	51	Esc. prob. biased low. There was no below fence est. this year and none estimated to pass fence during high water which happened a couple of times.
1996	64	63		43	106	170	No jacks noted. Below fence estimate obtained from the difference between the FO estimate and SEP estimates of natural spawners.
1995	149	540	6	205	751	900	No jacks noted. Below fence estimate obtained from the difference between the FO estimate and SEP estimates of natural spawners.
1994	32	131		213	344	376	No jacks noted. Below fence estimate obtained from the difference between the FO estimate and SEP estimates of natural spawners.
1993	91	234		175	409	500	No jacks noted. Below fence estimate obtained from the difference between the FO estimate and SEP estimates of natural spawners.
1992	260	1854		136	1990	2250	No jacks noted. Below fence number from FO.
1991	30	203		75	278	308	No jacks noted. Below fence number from FO.
1990	302	619	295		914	1216	No jacks noted.
1989	591	2900		200	3100	3691	2900 includes 2 identified as jacks.
1988	636	3307		1100	4407	5043	3307 includes 2 identified as jacks.
1987	519	1160		800	1960	2479	1160 includes 12 identified as jacks.
1986	495	1940		265	2205	2700	1940 includes 18 identified as jacks. Below fence estimate obtained from the difference between the FO estimate and SEP estimates of natural spawners.

[1]Numbers of natural spawners are the same as in our database (Appendix 1).
[2]These numbers are incomplete because numbers of fish harvested are not included.

Table 3.4 Escapement Statistics for Louis and Lemieux Creeks, North Thompson, 1993-1997.

Year		Louis Creek			Lemieux Creek		
		Male	Female	Total	Male	Female	Total
1997	spawning escapement above the fence (m/r±95%CL)	101±36	52±39	153±53	346±59	182±32	528±67
	fish taken for brood	36	18	54	37	33	70
	fence induced mortalities	8	1	9	6	1	7
	carcasses (spawners) recovered below the fence	2	2	4	2	2	4
	total escapement (spawners+brood+mortalities)	147	73	220	391	218	609
	escapement from database			135			377
	CWT escapement	57	21	78	46	19	65
	male:female ratio (using total esc. sample)			2.0:1			1.8:1
	spawning escapement:database (fence count) ratio			1.1:1			1.4:1
1996	spawning escapement above the fence (m/r±95%CL)	204±70	78±26	282±74	91±21	67±16	159±26
	fish taken for brood	12	14	26	9	10	19
	fence induced mortalities	1	0	1	6	1	7
	carcasses (spawners) recovered below the fence	0	0	0	1	1	2
	total escapement (spawners+brood+mortalities)	217	92	309	107	79	186
	escapement from database			211			131
	CWT escapement	75	41	116	40	37	77
	male:female ratio (using total esc. sample)			2.4:1			1.4:1
	spawning escapement:database (fence count) ratio			1.3:1			1.2:1
1995	spawning escapement above the fence (m/r±95%CL)	220±53	271±77	491±94	500±132	421±122	921±179
	fish taken for brood	37	56	93	21	13	34
	fence induced mortalities	7	2	9	11	7	18
	carcasses (spawners) recovered below the fence	0	0	0	2	0	2
	total escapement (spawners+brood+mortalities)	264	329	593	534	441	975
	escapement from database			352			300
	CWT escapement	103	78	181	189	137	325
	male:female ratio (using total esc. sample)			0.8:1			1.2:1
	spawning escapement:database (fence count) ratio			1.4:1			3.1:1
1994	spawning escapement above the fence (m/r±95%CL)	233±39	55±22	288±44	492±37	444±27	936±46
	fish taken for brood	90	42	132	71	45	116
	harvested	4	2	6	2	1	3
	total escapement (spawners+brood+mortalities)	366	99	426	565	517	1055
	escapement from database			259			708
	CWT escapement			7			53
	male:female ratio (using total esc. sample)			3.7:1			1.1:1
	spawning escapement:database (fence count) ratio			1.1:1			1.3:1
1993	spawning escapement above the fence (m/r±95%CL)	367±154	187±86	554±177	342±37	193±11	535±38
	fish taken for brood	54	70	124	33	26	59
	harvested	2	1	3	21	18	39
	total escapement (spawners+brood+mortalities)	423	344	681	396	237	633
	escapement from database			290			564
	CWT escapement			39			73
	male:female ratio (using total esc sample)			1.2:1			1.7:1
	spawning escapement:database (fence count) ratio			1.9:1			0.9:1

Table 4.1 Summary of post-orbital hypural length statistics (with standard deviations and 95% confidence intervals) for coho from Coldwater River (L. Thompson) and Dunn Lake and Lemieux Creek (N. Thom).

System	Return Year	Sex	Mean Lgth (mm)	Sample Size	Std Dev	Conf. Intervals
Coldwater R	1986	Female	454.5	4	23.7	23.2
		Male	404.2	6	41.3	33.1
	1987	Female	423.7	28	28.1	10.4
		Male	413.3	28	46.9	17.4
	1988	Female	426.9	153	31.9	5.1
		Male	382.0	179	33.4	4.9
	1989	Female	437.7	46	36.4	10.5
		Male	420.4	59	39.7	10.1
	1990	Female	441.8	62	33.0	8.2
		Male	418.8	72	37.6	8.7
	1991	Female	447.6	48	39.1	11.1
		Male	407.5	47	38.7	11.1
	1992	Female	453.2	54	34.7	9.3
		Male	429.4	51	37.9	10.4
	1993	Female	431.3	39	34.5	10.8
		Male	400.8	33	47.2	16.1
	1994	Female	438.1	22	25.7	10.7
		Male	405.5	17	34.9	16.6
Dunn Creek	1985	Female	469.9	184	41.6	6.0
		Male	449.7	139	56.5	9.4
	1986	Female	418.4	21	28.1	12.0
		Male	389.9	30	37.7	13.5
	1987	Female	415.0	213	42.6	5.7
		Male	379.4	165	32.1	4.9
	1988	Female	428.4	117	43.7	7.9
		Male	400.1	135	49.0	8.3
	1989	Female	412.7	48	47.7	13.5
		Male	395.4	34	57.4	19.3
	1991	Female	443.0	168	46.7	7.1
		Male	421.0	212	52.3	7.0
	1992	Female	434.0	228	36.4	4.7
		Male	410.0	315	47.3	5.2
	1993	Female	424.0	30	33.3	11.9
		Male	406.0	74	41.5	9.5
	1994	Female	452.0	99	32.9	6.5
		Male	428.0	105	44.6	8.5
	1997	Female	386.9	53	30.7	8.3
		Male	363.5	82	37.4	8.1
Lemieux Cr	1986	Female	407.6	8	43.8	30.3
		Male	389.1	11	45.3	26.8
	1988	Female	405.0	64	44.0	10.8
		Male	390.4	62	73.2	18.2
	1991	Female	444.0	48	35.2	10.0
		Male	424.0	102	42.8	8.3
	1992	Female	427.3	14	38.1	19.9
		Male	412.1	30	40.2	14.4
	1993	Female	439.0	18	35.3	16.3
		Male	380.0	20	34.1	14.9
	1994	Male	391.0	4	43.2	42.4
	1995	Female	414.0	103	36.2	7.0
		Male	395.8	132	37.9	6.5
	1996	Female	442.0	20	56.9	24.9
		Male	412.4	36	54.6	17.8

Table 4.2 Fecundity estimates at DFO-HEB facilities in Thompson and Lower Fraser rivers, 1987-97 plus mean annual fecundities with SD's and 95% confidence intervals.

Return	Chilliwack		Inch		Deadman		Spius		Salmon		Coldwater		Dunn		Lemieux		Louis		All	Systems	
Year	n	Fecundity	n	Fecundity	n	Fecundity	n	Fecundity	n	Fecundity	n	Fecundity	n	Fecundity	n	Fecundity	n	Fecundity	Mean	SD	CI
1997	1402	1967	302	1610	45	1142	153	925	5	1252	58	1303	32	1109	26	1326	10	1809	1383	343	224
1996	1103	2365	247	1383	105	638	116	1427	22	1640	23	1478	0	?	10	850	13	615	1300	587	407
1995	1097	2384	360	2029	112	670	180	1471	88	1855	124	1635	55	696	NA	NA	56	699	1430	670	464
1994	881	2711	149	2287	76	921	138	1916	20	1832	131	2106	34	1765	40	1600	35	1714	1872	494	322
1993	1123	2124	203	1737	40	1250	151	1203	42	1472	138	1510	20	1093	10	2033	16	1775	1577	365	239
1992	1073	2182	184	2094	28	1541	74	1345	122	1559	234	1646	N/A	N/A	N/A	N/A	N/A	N/A	1728	334	267
1991	819	2913	139	2249	N/A	N/A	68	1607	8	1602	246	1956	N/A	N/A	N/A	N/A	N/A	N/A	2065	545	478
1990	852	2907	139	2132	N/A	N/A	87	2087	149	2213	240	2033	70	1600	53	1747	33	1919	2079	423	313
1989	976	2669	122	2373	41	1570	68	1753	302	1998	235	2031	61	1705	59	1522	55	1467	1899	409	267
1988	885	2841	165	2069	12	1300	19	1700	325	1713	284	1971	68	2004	57	1237	107	1274	1790	511	334
1987	776	2873	62	2232	0	?	65	1700	279	1855	297	1888	97	2490	0	?	N/A	N/A	2050	417	334
Mean		2540		2018		1129		1558		1726		1778		1558		1474		1409	1688		
SD		347		311		359		329		264		273		573		381		508			

Note

n is number of females in sample.

1997 Chilliwack - preliminary-based on un-adjusted green egg number

Fecundities for Deadman, Dunn, Lemieux, Louis are estimates rather than counts

Table 4.3 Sex ratios for coho returning to streams in the Thompson

Stream	Ret. Year	Male	Female	Jacks	Total	% Male	% Female	Stream	Ret. Year	Male	Female	Jacks	Total	% Male	% Female	% Jack
Dunn Creek	1997	200	131	0	331	60.4	39.6	Eagle River	1997							
	1996	108	103	0	211	51.2	48.8		1996	118	123	13	254	46.5	48.4	5.1
	1995	234	158	0	392	59.7	40.3		1995	219	195	14	428	51.2	45.6	3.3
	1994	557	505	0	1062	52.4	47.6		1994	707	731	47	1485	47.6	49.2	3.2
	1993	354	233	0	587	60.3	39.7		1993	333	210	1	544	61.2	38.6	0.0
	1992	1027	957	0	1984	51.8	48.2		1992	1631	1421	0	3052	53.4	46.6	0.0
	1991	693	596	0	1289	53.8	46.2		1991	1083	740	2	1825	59.3	40.5	0.1
	1990	423	349	0	772	54.8	45.2		1990	1430	1176	0	2606	54.9	45.1	0.0
	1989	145	193	0	338	42.9	57.1		1989	1778	1674	0	3452	51.5	48.5	0.0
	1988	784	713	0	1497	52.4	47.6		1988	4297	4255	0	8552	50.2	49.8	0.0
	1987	273	227	0	500	54.6	45.4		1987	5659	4337	9	10005	56.6	43.3	0.1
	1986	292	298	0	590	49.5	50.5		1986	2306	1885	23	4214	54.7	44.7	0.5
	1985	567	997	0	1564	36.3	63.7									
								Salmon River	1997	22	12	0	34	64.7	35.3	0.0
Lemieux Cr.	1997	209	137	0	346	60.4	39.6		1996	73	54	0	127	57.5	42.5	0.0
	1996	83	66	0	149	55.7	44.3		1995	61	88	0	149	40.9	59.1	0.0
	1995	187	147	0	334	56.0	44.0		1994	12	20	0	32	37.5	62.5	0.0
	1994	464	366	0	830	55.9	44.1		1993	46	45	0	91	50.5	49.5	0.0
	1993	341	223	0	564	60.5	39.5		1992	1243	871	0	2114	58.8	41.2	0.0
	1992	338	329	0	667	50.7	49.3		1991	129	88	0	217	59.4	40.6	0.0
	1991	734	665	0	1399	52.5	47.5		1990	498	423	0	921	54.1	45.9	0.0
	1990	234	358	0	592	39.5	60.5		1989	1680	1809	2	3491	48.1	51.8	0.1
	1989	187	202	0	389	48.1	51.9		1988	1993	1948	0	3941	50.6	49.4	0.0
	1988	173	257	0	430	40.2	59.8		1987	810	857	12	1679	48.2	51.0	0.7
	1987	59	57	0	116	50.9	49.1		1986	1317	1100	18	2435	54.1	45.2	0.7
	1986	600	441	0	1041	57.6	42.4									
								Bessette	1996	40	23	5	68	58.8	33.8	7.4
Louis Creek	1997	87	36	0	123	70.7	29.3	Deadman R.	1997	207	200	0	407	50.9	49.1	0.0
	1996	157	79	0	236	66.5	33.5		1996	317	265	0	582	54.5	45.5	0.0
	1995	242	204	0	446	54.3	45.7		1995	371	340	0	711	52.2	47.8	0.0
	1994	275	98	0	373	73.7	26.3		1994	321	294	0	615	52.2	47.8	0.0
	1993	165	125	0	290	56.9	43.1		1993	1647	1791	0	3438	47.9	52.1	0.0
	1992	217	147	0	364	59.6	40.4		1992	596	576	0	1172	50.9	49.1	0.0
	1991	205	211	0	416	49.3	50.7		1991							
	1990	70	39	0	109	64.2	35.8		1990							
	1989	475	393	0	868	54.7	45.3		1989	53	119	0	172	30.8	69.2	0.0
	1988	259	208	0	467	55.5	44.5		1988	624	1096	0	1720	36.3	63.7	0.0

Table 4.4 Ages of Thompson/upper Fraser coho adults from scale analysis.

System	Return Year	Gilbert - Rich Age	European Age	n	%
Bridge	1993	32	1.1	69	97.2
		42	1.2	1	1.4
		43	2.1	1	1.4
Deadman	1993	32	1.1	68	100
Lemieux	1994	22	1	1	0.4
		32	1.1	217	96
		42	1.2	1	0.4
	1995	32	1.1	183	100
	1996	32	1.1	36	72
		43	2.1	14	28
Louis	1993	32	1.1	75	93.8
		43	2.1	5	6.2
	1994	32	1.1	16	84.2
		43	2.1	3	15.8
	1995	32	1.1	61	98.4
		43	2.1	1	1.6
	1996	32	1.1	8	42.1
		43	2.1	9	47.4
		54	3.1	2	10.5

Table 4.5 Ages of Thompson River coho juveniles from scale analysis.

System	Sample Dates	Gilbert - Rich Age	European Age	n	%
Deadman	Apr-June, 1995	11	0.1	31	12.8
		22	1	212	87.2
Lemieux	Sept-Oct, 1993	11	0.1	322	99.1
		22	1	3	0.9
North Thomps	Oct-Nov, 1995	11	0.1	18	72
		22	1	7	28
	Sept, 1996	11	0.1	100	80.6
		22	1	24	19.4
	Sept-Oct, 1997	11	0.1	111	65.7
		22	1	58	34.3

Table 5.1 Estimates of freshwater catch of coho in the upper Fraser River[1].

	1989	1990	1991	1992	1993	1994	1995	1996	1997
Sport Fisheries[1] (Eagle River)	60	60	<25	<25	<25	<25	<25	closed	closed
Aboriginal Fisheries[2]									
North Thompson	0	0	0	0	183	198	30	2	0
South Thompson	0	0	0	0	22	3	11	2	1
L. Thom/Up. Fraser	324	142	29	0	404	13	2	43	83
Total Thom/Up. Fraser	324	142	29	0	404	214	43	47	84
Total Fraser Abor. Fish.[3]	10245	13633	9386	6569	2162	11854	2441	1734	284

[1]Sport fisheries closed prior to 1989. Catch data from Byril Kurtz, DFO, Salmon Arm.
[2]North and South Thompson aboriginal catch data (Shuswap Bands) for 1994-1996 from Michael Galesloot. Affidavit Neskonlith Band vs Attorney General for Canada. L. Thom/Up. Fraser catch data for areas downstream of Bonaparte River from DFO catch files. 1997 North and South Thompson catch data from D. Ross Murray, 1997 Third Quarter Report 1997/98 Shuswap Nation Fisheries Commssion.
[3]Entire Fraser watershed.

Table 5.2 Relative Composition (Percentages) of Thompson/upper Fraser River coho in Samples from the Lower Fraser River during 1997.

Period	Tangle Net		Pink Survey		Test Fishery	
	n	%	n	%	n	%
Before 15 Sept.	65	40.8	81	81.5	21	17.8
16-22 Sept.	62	34.3	46	59.5	54	8
23 Sept. - 2 Oct.	237	21.2	83	57	40	6.8
3-8 Oct.	84	5.9	0	-	13	15.1
9-15 Oct.	85	1.5	0	-	30	6.7
16 Oct. - 13 Nov.	60	0.3	0	-	38	4.3

Note - data courtesy of T. Beacham, PBS

Table 6.1 Estimates of Survivals to Adult (3 yrs old) and Marine Fishery Expoitation Rates for Enhanced Fish Released into Eagle River and Salmon River (S. Thompson) and Louis and Lemieux Coho (N. Thompson).

Return Year	Stream	Life Stage Released	Number CWT'ed	Estimated Can. Catch	Estimated Wa/Ore Catch	Estimated Total Catch	Estimated Escape.	Percent Survival	Can. Mar. Exploit.	Total Mar. Exploit.
1987	Eagle	Spring Fry	128519	755	127	882	863	1.36	0.43	0.51
	Eagle	Fall Fry	81174	723	174	897	727	2.00	0.45	0.55
	Eagle	Smolts	26983	360	80	440	521	3.56	0.37	0.46
	Salmon	Spring Fry	102835	672	119	791	482	1.24	0.53	0.62
	Mean							2.04	0.45	0.53
1988	Eagle	Spring Fry	146315	1298	341	1639	489	1.45	0.61	0.77
	Eagle	Fall Fry	45392	623	157	780	267	2.31	0.60	0.74
	Eagle	Smolts	29685	817	186	1003	354	4.57	0.60	0.74
	Salmon	Spring Fry	104433	1114	200	1314	806	2.03	0.53	0.62
	Mean							2.59	0.58	0.72
1989	Eagle	Spring Fry	141046	699	182	881	309	0.84	0.59	0.74
	Eagle	Fall Fry	45772	506	99	605	356	2.10	0.53	0.63
	Eagle	Smolts	30704	1180	246	1426	899	7.57	0.51	0.61
	Salmon	Spring Fry	103770	665	265	930	549	1.43	0.45	0.63
	Mean							2.99	0.52	0.65
1990	Eagle	Spring Fry	94328	420	160	580	91	0.71	0.63	0.86
	Eagle	Fall Fry	49041	420	40	460	226	1.40	0.61	0.67
	Eagle	Smolts	65027	1167	168	1335	498	2.82	0.64	0.73
	Salmon	Spring Fry	106743	348	70	418	184	0.56	0.58	0.69
	Mean							1.37	0.61	0.74
1991	Eagle	Spring Fry	101162	127	72	199	86	0.28	0.45	0.70
	Eagle	Fall Fry	51006	54	27	81	51	0.26	0.41	0.61
	Eagle	Smolts	64528	99	43	142	98	0.37	0.41	0.59
	Salmon	Spring Fry	112509	129	35	164	44	0.18	0.62	0.79
	Mean							0.27	0.47	0.67
1992	Eagle	Spring Fry	81200	441	41	482	94	0.71	0.77	0.84
	Eagle	Fall Fry	48460	319	22	341	64	0.84	0.79	0.84
	Eagle	Smolts	56482	825	51	876	168	1.85	0.79	0.84
	Salmon	Spring Fry	109322	573	53	626	203	0.76	0.69	0.76
	Mean							1.04	0.76	0.82
1993	Eagle	Spring Fry	53118	109	28	137	15	0.29	0.72	0.90
	Eagle	Fall Fry	56336	152	38	190	15	0.36	0.74	0.93
	Eagle	Smolts	57872	128	18	146	15	0.28	0.80	0.91
	Salmon	Spring Fry	56373	150	17	167	46	0.38	0.70	0.78
	Mean							0.33	0.74	0.88
1994	Eagle	Fall Fry	52817	29	2	31	40	0.13	0.41	0.44
	Salmon	Smolts	9700	47	0	47	62	1.12	0.43	0.43
	Mean							0.63	0.42	0.43
1995	Eagle	Spring Fry	96353	212	52	264	44	0.32	0.69	0.86
	Eagle	Smolts	35963	210	16	226	44	0.75	0.78	0.84
	Salmon	Spring Fry	49910	97	7	104	136	0.48	0.40	0.43
	Salmon	Smolts	20360	113	13	126	144	1.33	0.42	0.47
	Lemieux	fry	19831	110	15	125	260	1.94	0.29	0.32
	Lemieux	smolt	7636	65	22	87	65	1.99	0.43	0.57
	Louis	smolt	9093	143	20	163	181	3.78	0.42	0.47
	Mean							1.51	0.49	0.57
1996	Eagle	Fall Fry	35116	107	16	123	13	0.39	0.79	0.90
	Salmon	Fall Fry	35654	26	4	30	29	0.17	0.44	0.51
	Lemieux	smolt	17170	347	33	380	77	2.66	0.76	0.83
	Louis	smolt	13050	456	39	495	116	4.68	0.75	0.81
	Mean							1.97	0.68	0.76
1997	Lemieux	smolt	10000	12	6	18	65	0.83	0.14	0.22
	Louis	smolt	10000	41	33	74	78	1.52	0.27	0.49
	Mean							1.18	0.21	0.35

Table 7.1 Index of coho escapements in 1996 and 1997 expressed as the proportion of two longer term average base periods.

Stock Aggregate		1984-97	1975-97
South wild	19 streams	0.15	0.16
South wild	5 streams	0.23	0.25
South enhanced	2 streams	0.05	0.06
North wild		0.31	0.34
North enhanced		0.57	0.36
Lower wild+enhanced		0.62	NA

Appendix 1. Coho escapements and stream lengths (km total and accessible to coho) in the South Thompson.

STREAM	Total	Access.	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
Adams R (lwr)	11.3	11.3	200	10	338	150	100	200	100	100	100	650	500	150	150	500	350	100	100	250	20	70	75	16	40
Adams R (up)	187.4	187.4	60	50	150	100	475	75	100	200	300	200	500	1100	500	700	1100	?	100	0	?	?	?	120	105
Bessette Cr	38	38	750	25	70	0	50	60	10	15	20	50	50	60	60	50	40	50	0	100	?	100	150	32	38
Blurton Cr	12.3	1.5	?	25	40	10	25	16	15	0	0	50	50	50	50	70	35	50	0	50	30	8	0	0	0
Bolean Cr	23.3	23.3	?	50	0	50	50	20	55	100	50	10	100	50	0	50	35	35	0	0	?	0	20	0	?
Canoe Cr	10.6	4.5	25	10	0	100	10	60	30	80	20	30	100	30	100	75	100	50	30	20	25	6	10	0	10
Cayenne C	46	2.1	15	?	10	40	125	?	35	225	50	36	?	100	75	50	0	?	?	?	?	?	?	?	?
Creighton Cr	30.7	4.1	?	40	2	30	30	10	20	20	20	100	500	60	100	200	150	25	25	150	12	?	50	0	5
Duteau Cr	49.6	10.8	?	325	94	400	300	350	250	200	500	750	600	750	750	800	700	350	0	500	12	?	200	30	0
Eagle R	81.1	81.1	1500	1100	2694	2000	2500	1500	850	1000	1200	7100	3500	4075	10584	9556	5114	3885	1362	3032	761	1485	800	254	150
Harris Cr	31.8	18.1	?	105	0	150	150	70	65	85	70	100	200	250	40	250	300	50	25	200	20	?	75	0	?
Hunakwa Cr	7.5	7.5	25	25	0	200	75	42	25	50	50	125	0	0	0	150	120	30	75	120	?	?	60	2	20
Ireland Cr	25.3	3.2	?	?	?	15	45	32	30	30	30	20	30	25	25	40	30	0	0	30	?	?	25	1	2
Johnson Cr	11	11	?	?	?	?	?	?	?	40	0	100	25	50	50	90	50	50	30	50	24	6	25	8	15
Kingfisher Cr	28.3	28.3	25	10	62	10	25	0	25	100	75	25	25	80	120	150	50	0	0	45	60	32	25	0	50
Momich Cr	16.7	16.7	15	?	10	?	25	?	5	?	30	20	?	50	80	10	0	?	?	?	?	?	?	?	?
Noisey Cr	15.4	15.4	?	?	?	?	?	?	?	?	?	?	0	25	15	15	0	0	0	0	?	?	0	0	?
Onyx Cr	16.7	2	?	?	?	?	?	?	?	?	?	0	0	20	0	60	30	25	15	20	?	?	?	0	0
Salmon R	148.7	80	750	900	1588	1500	2000	1300	500	800	1000	1550	3800	2205	1960	4407	3100	914	278	1990	409	344	751	106	34
Scotch Cr	56.5	16	25	5	0	0	0	?	?	20	25	?	0	50	50	100	50	50	40	50	10	10	20	16	2
Seymour R	71	14.6	?	1	25	0	40	6	20	?	?	50	0	0	50	0	50	50	0	0	?	?	0	?	0
Shuswap R (lwr)	88.6	88.6	100	40	100	300	300	350	250	300	200	300	500	600	350	400	250	200	200	250	20	100	25	0	0
Shuswap R (mid)	76.1	21	150	60	594	350	500	550	250	350	250	700	1200	650	500	1200	500	200	300	800	20	300	50	120	200
Sinmax Cr	20.5	9.4	60	18	40	55	140	30	60	15	10	40	75	80	120	80	40	0	0	0	0	0	?	?	?
South Pass C	9.8	1.2	?	20	40	50	60	20	20	50	10	25	50	50	?	75	50	50	25	85	?	2	25	0	2
Tappen Cr	6.8	1.5	25	1	12	2	3	0	15	5	0	20	30	30	30	40	35	15	0	15	?	0	10	0	0
Trinity C	28.6	1.4	?	?	?	4	45	10	10	35	10	30	20	60	20	50	50	50	10	50	6	?	0	8	0
Wap Cr	47.7	29.3	150	20	516	300	400	250	100	225	80	150	250	200	450	250	250	200	75	300	?	180	50	?	35
TOTAL	1197.3	729.3	3875	2840	6385	5816	7473	4951	2840	4045	4100	12231	12105	10850	16229	19418	12579	6429	2690	8107	1429	2643	2446	713	708

Note:

1997 Kingfisher Creek estimate from a fence count on Danforth Creek and visual counts in Hunter Creek. There was no estimate of Kingfisher Creek.

1997 Eagle River not able to install fence this year. Estimate based on float surveys was 40 fish which was expanded to 150 with the assumption that not all fish were seen.

1997 Salmon River count probably biased low.

1996 and 1997 Bessette Creek fence counts were 64 and 38 coho respectively; these fish will spawn in Bessette, Duteau, Harris and Creighton creeks.

Appendix 2. Coho escapements and stream lengths (km total and accessible to coho) in the North Thompson

Stream	Total	Access	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
Albreda R	30.8	30.8	?	?	440	180	200	325	500	550	1000	?	?	?	800	850	2300	800	50	200	100	0	0	0	0
Avola Cr	4.2	4.2	?	?	?	5	?	?	?	?	40	0	0	0	0	0	0	10	20	120	100	126	40	20	20
Bar. R	75.5	75.5	300	360	420	400	400	60	350	450	250	500	425	100	500	600	175	?	0	100	100	?	85	?	0
Blue R	31.5	17.1	250	10	510	600	600	300	300	450	350	?	0	?	500	250	450	50	20	30	1	0	0	0	0
Brookfd. Cr	23.6	1.1	?	?	?	?	?	?	?	?	?	?	0	?	?	?	?	?	?	12	0	0	0	10	?
Cedar Cr	7	7	?	?	15	15	175	40	30	30	90	?	0	?	80	?	60	20	0	0	?	0	0	0	0
Clearwt. R	172	48.4	400	500	1500	400	400	100	200	200	?	?	?	50	50	150	120	100	?	10	?	?	?	10	?
Cook Cr	7.7	7.7	?	?	?	60	60	10	45	50	100	?	0	65	200	25	70	100	10	20	4	0	0	0	0
Crossing Cr	4.6	4.6	?	?	?	?	?	?	?	?	40	?	0	10	5	10	0	?	?	?	?	?	13	10	4
Dunn Cr	20.7	20.7	350	460	530	700	400	210	550	500	100	950	700	425	1250	700	375	1400	1574	1990	587	1063	280	150	335
E. Bar. R	41.6	41.6	60	30	18	110	120	25	60	75	100	250	140	250	100	225	160	?	0	0	50	0	50	10	?
Fennel Cr	24.1	24.1	90	95	380	300	600	40	100	450	280	700	450	1250	580	800	60	200	?	?	?	50	0	?	0
Finn Cr	27	4.6	15	8	6	100	15	25	110	10	450	?	?	200	200	450	150	20	?	10	?	?	3	?	0
Goose Cr	4.8	4.8	?	?	?	?	?	?	?	?	20	?	0	?	?	?	?	?	?	?	?	0	0	0	?
Haggard Cr	20.1	20.1	?	?	?	?	30	5	?	5	?	1	0	5	0	?	4	?	?	10	?	0	0	0	?
Lemieux Cr	39.8	13.4	400	250	600	600	200	180	550	400	325	1200	500	850	0	950	600	600	1408	667	564	708	300	131	377
Lion Cr	17.1	4.8	600	500	600	2300	250	300	700	1200	1000	1150	1100	1600	500	1500	650	600	230	530	100	150	1000	500	550
Louis Cr	59.6	59.6	1200	1330	2200	1300	1400	700	950	750	200	700	650	1000	1525	600	500	110	416	364	290	259	352	211	135
Mahood R	26.2	2.8	25	?	10	12	5	?	?	?	?	?	0	5	0	0	?	?	?	?	?	?	?	?	?
Mann Cr	56.7	11.2	8	26	60	20	?	20	?	20	45	110	?	60	60	60	15	?	?	0	?	1	78	20	65
McTag. Cr	5.5	2.4	20	10	65	80	40	10	35	35	15	20	66	60	0	20	?	?	?	?	?	?	32	0	?
N. Thom. R	359.4	359.4	1500	1500	400	300	125	100	300	90	125	700	100	500	500	600	680	774	667	740	350	358	150	92	200
Raft R	79.2	4.7	500	250	350	250	120	90	110	200	250	960	?	800	400	650	170	50	200	100	50	301	40	15	?
Reg Chris. Cr	20.9	0.5	?	50	8	20	5	10	15	15	5	25	0	25	0	15	22	200	24	70	1	0	0	20	30
Shannon Cr	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	15	2	0	4	20	0	7	5	10
Tumtum Cr	7.4	7.4	6	?	10	10	4	4		2	50	25	25	80	0	0	25	26	0	45	12	2	2	0	40
Wireca. Cr	8.4	8.4	?	?	?	?	?	30	30	100	150	?	25	45	0	60	130	150	0	400	15	0	70	10	20
TOTAL	1175.4	786.9	5724	5379	8122	7762	5149	2584	4935	5582	4985	7291	4181	7380	7250	8515	6731	5212	4619	5422	2344	3018	2502	1214	1786

Note:
Albreda, Blue, Cedar, Cook, upper N. Thompson and Goose all have had few coho since 1994 due to a rock slide at Little Hells Gate on the N. Thompson River.
Lion Cr escapement in 1995 and 1996 is thought to be high due to the rock slide at Little Hells Gate. Coho that normally would have spawned above L. Hells Gate prob. spawned in Lion Ck.

Appendix 3. Coho escapements and stream lengths (km total and accessible to coho) in the lower Thompson/Upper Fraser.

Stream	Total	Access.	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
Bonaparte River	178.1	143.3	?	?	?	25	0	?	100	31	10	26	42	?	?	6
Bridge River	154.5	40.7	600	750	170	550	850	595	400	300	900	900	150	220	125	200
Coldwater River	90.4	90.4	?	?	1477	1600	2000	2500	3000	1500	3000	4000	3500	?	?	800
Deadman River	113.6	48.9	1500	550	390	2176	1722	231	273	1561	1225	3438	747	573	353	407
Nahatlatch River	85.9	85.9	?	200	?	250	1500	1565	600	?	?	?	?	?	?	?
Nicola River (upper)	52	22	?	?	?	?	?	?	?	?	?	?	?	49	4	4
Portage Creek	2.9	2.9	80	90	70	100	175	195	150	100	6	150	?	?	?	150
Seton River + Cayoosh	6.4	6.4	120	180	70	60	70	45	55	25	68	60	50	?	?	9
Spius Creek	48.6	48.6	?	?	300	375	100	527	1000	663	600	860	?	?	?	3000
Stein River	67.1	47.1	?	?	?	?	?	105	100	?	?	?	?	?	?	?
Yalakom River	59.6	59.6	?	?	?	?	?	?	?	?	?	?	?	?	?	0
TOTAL	859.1	595.8	2300	1770	2477	5136	6417	5763	5678	4180	5809	9434	4489	842	482	4576

Note

1994 Deadman River fence count was 615.

Spius and Coldwater estimates are made by hatchery staff while collecting brood stock.

Anecdotal comments on returns were "that Spius had its largest return in 1997 and virtually all coho were hatchery fish. Coldwater returns were better in 1997 than 1996 however these are the two worst years ever."

Upper Nicola River accessible length includes from Nicola Lake to Douglas Lake outlet.