Estimation of coho encounters and Interior Fraser coho impacts

in Lower Fraser gillnet and Interior Fraser fisheries in 2014

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Introduction

Due to their conservation status over the last two decades, Interior Fraser coho (IFC) are one of the most important salmon stocks considered for the management of salmon fisheries in Southern BC. Numbers of returning adults declined in the early to mid-1990s, and IFC remains in a period of low productivity (Decker et al. 2014). In 2002, IFC was assessed by the Committee on the Status of Endangered Wildlife in Canada as *Endangered*. Accordingly, Fisheries and Oceans Canada (DFO) Fisheries Management (FM) requires estimates of fisheries impacts on IFC. These estimates of exploitation rate are also key data pieces feeding into FM requested scientific advice on fisheries planning, evaluating Pacific Salmon Treaty obligations, forecasting IFC pre-fishery abundance, and assessing IFC stock status.

Currently, Fraser River fishery impacts on IFC are calculated by applying the appropriate release mortality rates for the various gear types to estimates of released coho, then adding kept coho. In the Lower Fraser below Sawmill Creek the decay curve has been applied to all kept and released fisher related coho mortalities to determine IFC composition while all coho encountered above Sawmill Creek are assumed to be IFC. The quality of the scientific advice on IFC depends in part on the outputs of this process and therefore depends on the quality of the estimates of kept and released coho salmon in fisheries.

DFO has used several methods to estimate kept and released IFC in fisheries since the 1980s including direct observations of landed catch, on-board observations, and creel surveys. Since 1998, the majority of in-river fisheries have moved to non-retention for coho salmon and estimates of releases and release mortality rates have consequently become increasingly important in understanding fisheries' impacts on IFC. Until recently, salmon monitoring programs in many Pacific Region fisheries have focused on assessment of retained catch and therefore have relied primarily on fisher-reported information (*e.g.*, hails, logbooks) to produce estimates of releases of non-retention species including IFC.

Previous studies have found that fisher-reported releases were underestimated in Southern BC recreational and troll fisheries (Diewart et al. 2005; Velez-Espino et al. 2010) and that under-reporting encounters may be more pronounced with less abundant or non-target species like coho, chinook and steelhead (Bijsterveld et al. 2002). Reasons for under-reporting can be diverse and include recall bias, non-response, and other challenges associated with accurate reporting of low-abundance non-retention species. In the Strait of Georgia recreational fishery, the release rate for coho and chinook reported by anglers in the creel survey was approximately half the rate measured by fishery observers (45% and 48% respectively; Diewart et al. 2005), whereas in the WCVI troll fishery the release rate for sublegal-size

chinook reported in fisher logbooks was 60% of the rate measured by observers (Velez-Espino et al. 2010).

The period of the IFC migration through the Lower Fraser is from mid-August until mid-October (Figure 1; Irvine et al. 1999). In order to protect the migration of IFC, temporal and spatial closures have been in place for fisheries using non-selective gear since 1998. These restrictions, referred to as 'window closures', have been extensively outlined in fishery management plans and discussed with fisheries representatives on an annual basis. Given stronger expected returns of IFC in 2014, and to facilitate harvest of abundant co-migrating stocks of sockeye, openings were provided during September in weeks that typically fall within these window closures. As in recent years, the regulations for the Area E and First Nations (FN) Economic Opportunity (EO) fisheries specified non-retention for coho throughout the season. For FN Food, Social and Ceremonial (FSC) fisheries occurring outside of the window closure, regulations enabled retention of coho; no FSC licences were issued in the Lower Fraser First Nations fisheries during the closure period. 2014 was the first time in 17 years that Area E and FN EO gill net fisheries were open during the IFC window closure.

Due to concerns about the reliability of existing estimates of mandatory releases by fishers identified during the Marine Stewardship Council (MSC) Certification process, a small number of fisher-independent boat-side observers measured encounters of all non-target species (including coho) during the 2014 Area E fishery. Boat-side patrols observed sets representing from 0.3% to 2.9% of the total target catch in sockeye fisheries and from 1.9% to 3.1% in chum fisheries. To supplement this information on Coho encounter-rates, encounter data were reviewed from fisher-independent scientific test fisheries (chartered vessels with onboard observers) aimed at collecting information to support management of sockeye, chinook and chum returns to the Fraser River and tributaries. These, and other data sources (see Methods for details), were used to:

1. Estimate coho encounters in the Lower Fraser gillnet and fisheries in the Interior Fraser; as well as,
2. Estimate IFC encounters and mortalities in the Lower Fraser gillnet fisheries.

Methods

Estimation of Coho Encounters

In Lower Fraser gillnet fisheries, coho encounters were estimated using five methods: logbook, FN FSC and EO catch monitoring program, Area E observers, test fisheries, and pooled Area E observers and test fisheries. In Interior Fraser fisheries, coho encounters were estimated using census or survey based catch monitoring methods and other ancillary information: logbook, vessel-based observer, independent validation, test fishery, and other fishery data.

Lower Fraser Gill Net Fisheries

Since approximately 1996, final commercial catch for Lower Fraser River commercial fisheries have been estimated mainly using data reported by fishers in phone-in and logbooks with adjustments for the

compliance rate of submitted phone-in/logbook reports (DFO 2009). Since 2010, this fisher-reported information has been supplemented by the implementation of a Dockside Monitoring Program (DMP) which validates a portion of the catch during sockeye fisheries. The official estimates of kept and released coho for the Area E gill net fishery were those calculated by the fishery manager, and reported in the Fishery Operating System (FOS). The estimates of sockeye catch during the sockeye-directed fishery and the estimates of chum catch during the chum-directed fisheries are considered to be higher quality than release estimates.

Use of Observer Data to Expand Coho Encounters in LFR Gill Net Fisheries

Monitoring programs for FN fisheries in the Lower Fraser River vary by group, geographic location, and fishery purpose (*i.e.* FSC or EO). Details of monitoring programs for FSC fisheries can be found online at: http://www.pac.dfo-mpo.gc.ca/fm-gp/fraser/abor-autoc-eng.html. The base monitoring programs assessing retained catch for EO fisheries are consistent throughout the area and are comprised of a 100% mandatory landing program conducted by the FN monitoring organizations. Beach seine and shallow seine fisheries have an additional requirement for 100% on-board/beach side observer coverage because of their high fishing capacity, potential to impact stocks of concern, and use of selective gear. Gill net fisheries were not required to have any on-board observer coverage in 2014.

DFO has used independent observer programs to assess the accuracy and precision of fisher-reported estimates, especially for non-retainable catch components (DFO 2009). For the Area E gill net fishery, a boat-side observer program was employed in 2014, with at least one observation vessel operating during each opening. There were no boat-side observers for the FN FSC and EO gill net fisheries. When collecting observations, boat-side observers were located in a separate vessel near to the commercial fishing vessel that was being monitored with a clear view of the net emerging from the water. Observers were able to identify most fish to species; however when it was difficult to directly observe the species, the fisher was asked to identify the species. The observers recorded the number of fish by species as kept or released. The observer program involved staff from DFO and a contractor with boat-side monitoring experience.

For the sockeye-directed fisheries, coho encounters were estimated by multiplying the weekly ratio of coho to sockeye from the observer data by the weekly sum of sockeye catch estimates for the Area E, FN EO and FN FSC fisheries. For the chum-directed fisheries, coho encounters were estimated by multiplying the weekly ratio of coho to chum from the observer data by the weekly sum of chum catch estimates for the Area E, FN EO and FN FSC fisheries. During weeks 102 and 103, (*i.e.* second and third weeks of October), only the FN FSC gill net fishery was conducted, thus there were no observer data to generate observer-based estimates of coho encounters.

Use of Test Fisheries to Expand Coho Encounters in LFR Gill net Fisheries

To support the management of the Fraser sockeye fishery, test fisheries at Cottonwood (near Steveston, BC) and Whonnock (near Fort Langley, BC) were conducted in 2014, as in other years, by the Pacific Salmon Commission and the Qualark test fishery (near Hope, BC) was conducted by Yale First Nation and DFO. The Albion chum test fishery (near Fort Langley, BC) was also conducted in 2014, as in other years,

by DFO to support the management of the Fraser River chum fishery. Date and mesh size were recorded as well as kept and released species. Catch data from test fisheries are regarded as more accurate than data from other types of fisheries that rely on fisher-dependent information for several reasons: i) the number of participating vessels is known; ii) there are independent observers on board all test fisheries except Qualark; iii) participating fishers are proficient at species identification and catch recording techniques; iv) record keeping is thorough; and v) data collection and analysis is conducted soon after fishing (DFO 2009).

In Lower Fraser River Area E, FN EO and FN FSC sockeye-directed fisheries, coho encounters were estimated by multiplying the weekly reported sockeye catch from each fishery by the coho to sockeye ratio from the Cottonwood and Whonnock data (data from mesh sizes less than 5½ inches). For the chum-directed Area E, FN EO and FN FSC fisheries, coho encounters were estimated by multiplying the weekly reported chum catch from each fishery by the coho to chum ratio from the Albion chum net data (6 ¾ inch mesh size).

Use of Combined Test Fishery and Observer Data to Expand Coho Encounters in LFR Gill net Fisheries

Coho encounters were also estimated by pooling the observer and test fishery data sources, as outlined above for the sockeye- and chum-directed fisheries. This method has been referred to in this document as 'combined'.

Non Gillnet Fisheries in the LFA

Coho encounters in other LFA fisheries were estimated using standard assessment techniques such as creel surveys, census programs or other survey based methods and are not included in this detailed review. See the 2015 Coho Discussion Document.

<u>Interior Fraser Fisheries</u>

In 2007, DFO implemented the Pacific Integrated Commercial Fishery Initiative by moving a share of commercial fisheries to near-terminal areas to support emerging policy, minimise mixed stock fisheries, and provide FN an increased opportunity to participate in commercial fisheries and fishery management. As these are new fisheries, monitoring is conducted at an enhanced level where 100% of the catch is landed and tallied at various known locations. In cases where released bycatch was a concern, observer coverage was required. In the Siska dipnet Demonstration fishery in the Fraser mainstem 100% of the catch required oversight by a fisher-independent monitor. In the purse seine Demonstration fishery in Kamloops Lake, the goal of the observer program was to sample 20% of the effort or sockeye catch when coho were thought to be present. Most Interior Fraser Demonstration fisheries were low effort and conducted at a very small spatial scale. In these cases all target catch and bycatch of coho was tallied at the fishing site. The most intensive Demonstration fishery in 2014 occurred in Kamloops Lake using one to two purse seine vessels. Kept coho catch in this fishery was estimated using reported mortalities observed by a third party observer at the plant, as well as fish transfer slips used by the site manager when Demonstration Fishery coho mortalities were transferred to FN for FSC purposes. Released catch was estimated by multiplying the weekly ratio of coho to sockeye

encounters from the observer data by the validated sockeye catch estimates. The numbers of IFC released were multiplied by gear-specific release mortality rates (from the South Coast IFMP) and summed with kept catch to estimate IFC mortalities.

Monitoring programs for FN FSC fisheries in the Interior Fraser River vary by group and area as a result of the geography and risk (in terms of access and harvest level for example) associated with the fishery. Details of monitoring programs for Interior Fraser FSC fisheries can be found online at: http://www.pac.dfo-mpo.gc.ca/fm-gp/fraser/docs/abor-autoc/UpperFraser/UMFHarvestReport-eng.htm.

FSC monitoring coverage in 2014 was consistent with recent years where target species catch and bycatch is reported by fishers in census and survey based programs with an independent assessment of effort in most survey based programs. There is minimal independent observer coverage of released catch in Interior Fraser FN FSC fisheries. Directed coho harvest data is assumed to be good quality given most harvest occurs at fishways or enumeration fences when abundance permits. Due to the lack of an independent observer program bycatch of coho in fisheries directed at other species is less certain. This is especially the case in fisheries that target Late-Run sockeye (fisheries below the Thompson/Fraser confluence and in the Thompson) due to the significant timing overlap with coho.

Due to concerns related to the lack of fisher-independent data, a test fishery conducted in the Lower Thompson River was used as an independent data source to confirm sockeye/coho ratios with other fisheries that were temporally and spatially representative. The Secwepemc Fisheries Commission, Skeetchestn Indian Band, and Bonaparte Indian Band conduct the test fishery in a rigorous manner using three different mesh-sized gill nets each set once per evening. In 2014 the test fishery operated from July 21st to September 21st. Coho were not encountered in the test fishery, so FSC gill net coho encounters estimated in the Thompson River FSC fisheries were not adjusted during this time period.

Significant dip net FSC fisheries took place in the Thompson River targeting Late-Run sockeye after September 21st. No Coho encounters were reported for this gear type during this period. A dip net Demonstration fishery was conducted by the Siska Indian Band in the Siska Canyon from September 26th to October 3rd. Monitoring coverage was good in this fishery. Coho encounters in the FN FSC fisheries conducted after September 21st in the Thompson River were estimated by multiplying the weekly ratio of coho released to sockeye from the Siska Indian Band Demonstration fishery by the sockeye catch estimated in the survey-based FSC catch estimate. The encounters were then scaled by the proportion of the 2014 escapement that migrated by the Siska Demonstration fishery but that was not anticipated to migrate into the Lower Thompson. Due to the geography of the fishery, and the regulations allowing bycatch retention, all encounters estimated were assumed to be retained.

Recreational fisheries targeting Early Summer and Late-Run sockeye in the Lower and South Thompson Rivers were estimated using access site and aerial survey based methods. The South Thompson fishery closed September 21st and estimated coho encounters were not adjusted. The Lower Thompson fishery remained open until October 19th. Coho encounters in the Lower Thompson recreational fishery were estimated using access site survey-based catch monitoring methods for the Savona and Juniper open

areas. For access sites where no coho were reported as encountered (Spences Bridge and Ashcroft) by the catch monitoring program, coho encounters were estimated using the average ratio of coho to sockeye observed at Savona and Juniper by the sockeye catch estimated in the survey based catch estimate at the Spence's Bridge and Ashcroft Access Sites. The rationale for taking this approach was that less of the catch was inspected at these sites and a lack of coho catch may be an artifact of a lower sampling rate rather than true absence.

Coho encounters in all other BCI fisheries were estimated using standard assessment techniques such as creel surveys, census programs or other survey based methods and are not included in detail in this review.

Estimation of IFC encounters

Lower Fraser Gill Net Fisheries

The Fraser River Decay Model was used to estimate IFC encounters and mortalities in lower Fraser fisheries. The Decay Model estimates the proportion of coho encounters that are IFC by day, based on an empirical fit of a Bayesian model to samples, assigned to stock of origin using genetic techniques, collected from a tangle tooth net that operated in the Fraser River near New Westminster from 1997-1999 (Irvine et al. 2000; Simpson et al. 2004). Then the estimated numbers of released IFC in each fishery were multiplied by the gear-specific release mortality rates (from the South Coast IFMP) to estimate IFC release mortalities and summed with estimates of retained IFC to assess total mortality. These estimates exclude drop out/off mortalities. One of the model's key assumptions is the stock composition temporal pattern is stationary among years and among fisheries from the mouth of the Fraser River to Hells Gate despite major spawning populations leaving the Fraser River at the Pitt, Chilliwack and Harrison rivers, which are located upstream of New Westminster.

The Qualark test fishery is another source of information that can be used to estimate the number of IFC encounters in the sockeye-directed fisheries. The Qualark test fishery records catches of coho, sockeye, and other species by day and mesh sizes. All coho caught at Qualark are assumed to be IFC since few lower Fraser coho spawn in the creeks between Qualark and Hells Gate. To estimate IFC encounters in the lower Fraser gill net fisheries, the daily catches of coho and sockeye were 'backed-up' by two and three days to represent the migration time from the gill net fisheries to Qualark. For the sockeye-directed fisheries, coho encounters were estimated by multiplying the weekly ratio of coho to sockeye from the Qualark data for mesh sizes less than 5½ inches to represent the gill nets used for the sockeye-directed fisheries by the weekly sockeye catch. The Qualark test fishery ended on October 4, 2014, thus, data from Qualark were not available to estimate IFC impacts in chum-directed fisheries, and yielded an incomplete estimate of IFC encounters. This method assumes that the majority of Fraser sockeye were returning to locations upstream of Qualark.

An additional, 'harvest rate', method was used to estimate IFC encounters based on harvest rate data and estimates of numbers of returning IFC adults. Run Reconstruction methods have been used to

estimate impacts on salmon stocks when information about the run timing and harvest rate are available following a variety of approaches described generally by Schnute and Sibert (1983) and Starr and Hilborn (1988). Harvest rates were calculated for sockeye for the sockeye-directed fisheries based on kept catch estimates and abundance measured by the Pacific Salmon Commission sonar program at Mission, BC. Harvest rate calculations accounted for the location of the fisheries relative to Mission to avoid double counting of sockeye. To estimate the percentage of the IFC run that was encountered each week, the weekly sockeye harvest rates were multiplied by the weekly proportion of the IFC migration. IFC run proportion was reported by Irvine et al. (1999) based on CWT recoveries of IFC in the Lower Fraser commercial gill net fishery scaled by effort from 1986 to 1994 (Figure 1). The percentage of the IFC run encountered weekly was summed over all weeks and was then multiplied by the gear-specific release mortality to estimate the terminal harvest rate. The estimated number of IFC encounters was calculated using the sum of the terminal harvest rates for each gill net fishery and the preliminary abundance of 19,000 (IFC spawners plus IFC removals upstream of Sawmill Creek). The estimate of IFC encounters is preliminary since preliminary estimates of IFC mortalities from other Fraser fisheries (*e.g.*, recreational, BCI FN FSC and EO) were used to estimate the terminal run. The sockeye harvest rate method assumes that sockeye and coho had equal vulnerability to the fishing gear. Both are similar in size, however little information was available to compare migration rates between sockeye and coho. The sockeye harvest rate method does not account for fishery impacts during October when there were no daily abundance estimates available from the PSC sonar program at Mission.

Interior Fraser Fisheries

In the Interior Fraser River all coho encounters are assumed to be IFC encounters.

Results

Lower Fraser River Gill Net Fisheries

In the Area E and FN EO gill net fisheries, the fisher-reported catches of salmon (Table 1) produced coho to sockeye encounter ratios (Table 3) that were much less than the ratios from the observer and test fishery and harvest rate data during the sockeye-directed fishery (Table 2). During the chum-directed Area E and FN EO fishery, the fisher-reported ratios of coho to chum were less than the ratios from the Area E observer data, but the test fishery ratios were larger than the FN EO ratios and lower than the Area E ratios. Further, the coho to chum ratios for the FN FSC fisheries were much greater than reported for the Area E fishery, Area E observers, and Albion test fisheries.

Coho encounter estimates from fisher-independent data sources were higher than the fisher-reported encounters for the sockeye-directed fisheries; however, the pattern was variable during the chum-directed fisheries (Table 4). During the chum-directed fisheries, the fisher reported estimates of coho encounters for the FN FSC fisheries were much greater than estimates based on Area E observers, the Albion test fishery, and their combination, whereas the opposite pattern occurred with the FN EO gill net fishery. For the Area E chum directed fishery, coho encounter estimates based on observer data

were greater than the estimates reported by the Area E fishers, however inclusion of the Albion test fishery data resulted in lower estimates than those reported by fishers.

IFC encounter estimates from fisher-independent data sources produced higher estimates than those reported by fishers when estimates were combined among Area E, FN EO and FN FSC sockeye- and chum-directed fisheries (Table 5). Among fisher-independent data sources, the smallest IFC encounter estimates were generated from Area E observer data whereas the largest estimates were from the Qualark test fishery data with an assumed migration time of three days. The sensitivity of the migration timing assumption (2 or 3 days) using Qualark test fishery data had significant impacts on the results. This variation is associated with the Qualark encounter rates being multiplied by different catch estimates in the fishery when the timing assumptions are considered.

Estimates of IFC mortalities were similar for the test fishery data (which covered the entire period of sockeye- and chum-directed fisheries in 2014) and Qualark two-day migration methods (which covered only the sockeye-directed fisheries in 2014), and less and slightly more variable between the combined test fishery, Area E observer data and the sockeye harvest rate methods (Table 6, Table 14). The lowest estimate was for the fisher-reported method.

Interior Fraser River Fisheries

Fisher reported estimates of coho encounters were lower in the FSC Demonstration fishery on Kamloops Lake except for the week ending September 28th (Table 7, 8). The observer sample rate was good but under the 20% goal (14% of the sockeye catch was observed between September 14th and October 19th). Due to the difference in fisher reported and fisher independent observations the coho releases were adjusted for the period of September 21st to October 12th. Released catch increased from the reported 625 to 1232. The kept catch remained the same and included logbook data that identified 145 retained for FSC and 37 identified as bycatch mortalities at the plant by a third party independent validator (182 total). In total, after applying a 10% release mortality rate to the released catch, the number of IFC mortalities for this fishery was 305, of which 145 were transferred to FSC.

No coho were encountered in the Lower Thompson River gill net test fishery by the week ending September 21st (Table 9). As there was very little gill net activity in First Nation FSC fisheries after this date, fisher reported FSC catch was not adjusted for this gear type. Significant dipnet FSC fisheries in the Lower Thompson River occurred after September 21st and there were no coho encounters reported by fishers (Table 10). A dipnet Demonstration fishery with enhanced monitoring in the Fraser Canyon encountered 78 coho during a period the FSC fishery in the Lower Thompson River was ongoing (Table 11). Due to the large difference in coho encounters between the fisher reported and fisher independent observations the FSC reported catch was adjusted for the period of September 22nd to October 5th. After adjustments 83 coho were estimated to be retained in the dipnet FSC fishery in the Lower Thompson River below the Bonaparte River.

A total of 10 coho were estimated to be released in two of the four access site fisheries in the Lower Thompson River recreational fishery (Table 12). Due to a lower inspected interview sample from the Ashcroft and Spences Bridge access sites the average Coho encounter rate from Savona and Juniper

(.08%) was used to adjust the coho encounters in the Lower Thompson River recreational fishery from 10 to 14. All encounters were assumed to be released and result in one IFC mortality, after a 10% release mortality rate was applied to the released coho.

All other fisheries in the Interior Fraser River and tributaries were not adjusted and coho encounters were assumed to be those estimated in the catch monitoring programs. The total IFC mortalities estimated in 2014 BC Interior fisheries is 441 (Table 13). These estimates include First Nation FSC mortalities above Hells Gate. It is important to note that prior to 2014 the mortalities in FN FSC fisheries above Hells Gate were not included in the post season exploitation rate estimates. The 2014 post-season estimate is lower than pre-season expectations. The difference can mostly be attributed to a Demonstration fishery in the Chilcotin River and coho directed FSC fisheries that did not occur as expected.

Discussion

Accurate estimates of IFC mortalities are very important for the management of fisheries in Southern BC and for international management of coho resources in the Southern Panel area. This document contains information relating to both the Lower Fraser Area and the BC Interior Areas. In 2014, fisheries in Southern BC were expanded considerably, compared to management actions over the last 15 years, to harvest more abundant (compared to previous years) stocks and species, such as Fraser River sockeye and West Coast Vancouver Island (WCVI) coho. In the Fraser River, a four week window closure is typically in place, starting in the Lower Fraser on the Tuesday after Labour Day, and extending to mid-October. In addition to adjustments made to the window closures, Late-Run sockeye returns to the Fraser River displayed protracted holding behaviour not observed in recent years. The effect of this delayed river entry pattern was that in-river sockeye-directed fisheries in the first and second weeks of September were significantly larger than anticipated pre-season. The later timing of these fisheries, and the reduction in the window closure duration, increased concerns around IFC encounters, and motivated this post-season review to ensure accurate estimates of impacts on co-migrating IFC. Given the high post-release mortality rates, and the timing of these fisheries, focus was placed on the Lower Fraser gill net fisheries for this initial review. This review does not address all fisheries in the Fraser. Estimates of Coho encounters in all other Fraser fisheries were estimated using standard approaches such as creels, census or other survey based programs and will be a part of the 2014 total mortality estimates outlined in the 2015 Coho Discussion Document.

Further analysis of uncertainties in catch/release estimates in the Fraser and the Marine Area is not complete. Further work is planned as part of CSAS reviews of methods used to estimate IFR coho exploitation rates planned for fall/winter 2015. In this memo, several methods were used to estimate coho and IFC encounters in 2014 Fraser River gill net fisheries. The data sources and methods we used were: 1) fisher-reported; 2) boat-side observer; 3) test fishery data; 4) combined boat-side observer and test fishery data; and 5) a sockeye harvest rate method. Multiple methods were used to explore various

hypotheses around biases in estimating IFC impacts associated with each type of data. These methods and datasets are briefly outlined below:

1) Fisher-reported data is the number of fish that individual fishers provide to DFO, mainly through interviews, log-books, and phone-ins. Research indicates that fisher-reported release rates can be underestimates, particularly in situations where non-retention species are in low abundance. When retention of less abundant stocks is allowed, fisher-reported catch estimates may be less likely to be underestimates. Assessing alternative estimation methods for IFC encounter rates was a motivation for this analysis given these factors.
2) Boat-side observer data was collected in 2014 by DFO, or contractor staff on vessels observing net-pick events in Area E gill net fisheries in the Lower Fraser River. Boat-side observer data provides a fisher-independent estimate of retained and released catch, on a set-by-set basis. If boat-side observer programs are successfully designed and implemented, a representative sample of fisheries can be assessed. However, the observer coverage levels may not be sufficient in some situations to produce reliable estimates. Observer species identification may be more accurate than fisher species identification. However, the logistical challenges related to closely observing fish in nets can lead to species mis-identification and numeration. Attempts are made to address this by communicating with fishers to confirm records where species identification is in question. Area E gill net observers in 2014 provided an important dataset to compare fisher-dependent data to.
3) Test fishery data is collected by vessels that operate in the Lower Fraser River. Sampling methods are designed to provide rigorous information to support management such as abundance estimates, species composition, stock composition, and migration run timing, for example. The high-quality species composition data provided by test fisheries provided a fisher-independent source of information in this analysis. Test fishing sampling occurs consistently throughout the time period, and within the same spatial distribution, of the Area E gill net fishery. The test fisheries differ from Area E gill net fisheries in that they follow a consistent fishing pattern based on tides, and have a limited net soak period. Because of these methodologies, sample sizes of IFC encounters can be very low in test fisheries, compared to Area E or EO fisheries. This is of particular concern for stocks of low abundance, where ability to detect their presence is limited.
4) Test fishery and observer data were combined in an attempt to deal with impacts of low sample sizes. The biases noted above for each of these data sources remain when data is combined. As described in the Methods and Results sections, the Decay Model curve was applied to weekly estimates of coho encounters in the Lower Fraser to obtain an estimate of the number of IFC encountered. The Decay Model curve assumes that all coho in the Lower Fraser are potentially IFC; it does not account for the relative abundances of Lower Fraser populations of coho. As well, the Decay Model curve assumes no inter-annual variability in Lower Fraser coho or IFC run timing. These assumptions introduce uncertainty into results obtained using the Decay Model curve. (See discussion below of 2015 Canadian Science Advice Secretariat review of the Decay Model.)

5) A final method using sockeye harvest rates was used to provide a further evaluation of coho encounter rates that was not subject to the above biases. This approach assumes that IFC migrating through the Lower Fraser are equally vulnerable to capture as co-migrating sockeye. While we did not expect this method to provide a management tool to estimate IFC encounter rates, it was valuable to conduct given that it used a different set of data and methodologies. In an attempt to avoid the issues associated with the assumptions of the Decay model curve, a second source of stock composition CWT data was used to estimate proportion of IFC in the harvest rate method (see Methods and Results sections for further detail).

The different approaches used to estimate IFC encounters in 2014 fisheries produced varying estimates of encounters. Boat-side observer programs conducted during the 2014 Area E fishery produced coho encounter estimates that were consistently greater than those reported by fishers for the sockeye- and chum-directed fisheries. Test-fishery information produced higher encounter rate estimates during sockeye-directed fisheries than fisher-reported data for all fisheries, and lower encounter rate estimates during chum-directed fisheries than fisher reported data from Area E and First Nations FSC fisheries. This pattern was generally consistent when test-fishery data was combined with information collected from boat-side observers. Estimates of encounters based on the harvest-rate approach were comparable to those produced by the combined approach in terms of total catch during the season but not on a weekly basis (Table 5).

The various approaches reviewed in this document produced a wide range of encounter rate estimates. This variability may suggest that there is uncertainty in the reliability of previous exploitation rate estimation approaches for gill net fisheries, though interpretation of 2014 post-season analysis results must consider the nature of the fill net fishery plan that year (*i.e.*, two weeks of heavy fishing in September during a period typically subject to gill net window closures). The pattern in difference among encounter rate estimates from the various methods differs between sockeye- and chum-directed fisheries, particularly as they relate to estimates relying on test-fishery information. This difference could be affected by milling, staging and other behavioural patterns varying among sampling locations. Review of existing data or consideration of potential species-specific behaviours could help elucidate this pattern. Even with this variability, coho encounter rates from boat-side observers were consistently higher than those reported by Area E and the EO gill net fisheries. This trend indicates that there may be a negative bias in the 2014 fisher-reported Area E and EO gill net coho release data. This is consistent with reviews of other southern BC fisheries where estimates of releases from fisher-reported catch monitoring techniques have been found to produce lower estimates than fisher-independent methods (Bijsterveld et al. 2002; Diewart et al. 2005; Velez-Espino et al. 2010).

This encounter rate analysis is a first step in a larger process to evaluate and better understand coho impacts occurring in Canadian waters. While not included in this analysis, similar reviews of Fraser River and marine fisheries encountering IFC would allow for a more complete assessment of fisheries impacts. This understanding is essential for improved escapement estimation and to inform management and conservation actions. Collection of other fisher-independent data from fisheries encountering IFC would further support this assessment, and would ensure that encounter rate estimates are representative of the fisheries to which they are being applied. Upcoming Canadian Science Advice Secretariat (CSAS)

meetings late in 2015 will review IFC exploitation rate approaches and will likely be informed by this and other analyses.

Another important source of uncertainty in IFC estimates for in-river fisheries relates to IFC stock composition estimates at various times and locations in the Lower Fraser. DNA sampling of wild coho occurred in 2014 fisheries, but sample collection from Fraser in-river areas was very limited compared to marine fisheries areas. Projects to review and update stock composition assumptions from IFC estimation models in-river would be helpful in increasing the confidence of current fisheries impact assessments.

Further review of this work will be required with First Nations and stakeholders to inform future fisheries monitoring and management approaches.

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Table 1. Fisher-reported estimates of kept and released catches of coho, sockeye, chinook, and chum salmon by statistical (stat) week and spatial area for the Area E, FN Economic Opportunity (EO), and FN food, social and ceremonial (FSC) gill net fisheries. Stat week 081 is the first week of August. Only stat weeks where fisheries data were available are included in the table.

		Mouth to Harrison				Harrison to Sawmill			
Fishery	Stat Week	Sockeye	Coho	Chum	Chinook	Sockeye	Coho	Chum	Chinook
Area E*	081								
	082	74,093	2	1	201				
	083	133,800	14	1	532				
	084	495,471	17	43	3,021				
	091	341,257	54	143	2,494				
	092	368,275	1,023	829	5,726				
	093	176,478	638	687	2,024				
	094								
	103								
	104	166	1,279	35,762	85				
	105	479	798	25,036	25				
Total		**1,590,019**	**3,825**	**62,502**	**14,108**				
FN EO	081	2,571	-	-	21	-	-	-	-
	082	48,678	2	1	158	23,619	-	-	234
	083	-	-	-	-	-	-	-	-
	084	83,021	-	9	641	28,505	-	8	419
	091	185,721	13	34	2,042	83,361	2	-	1,743
	092	83,836	40	76	1,211	33,371	10	5	1,122
	093	-	-	-	-	-	-	-	-
	103	-	-	-	-	-	-	-	-
	104	-	27	7,143	-	-	-	-	-
	105	-	3	12,973	-	25	-	992	-
Area Total		**403,827**	**85**	**20,236**	**4,073**	**168,881**	**12**	**1,005**	**3,518**
Total		**572,708**	**97**	**21,241**	**7,591**				
FSC	075	30,073	-	-	651	23,801	-	-	1,546
	081	83,169	-	7	875	44,631	-	-	1,252
	082	34,992	-	2	305	25,191	-	-	375
	083	41,755	-	-	190	15,296	-	-	159
	084	2,142	-	2	14	-	-	-	-
	091	1,132	-	3	180	-	-	-	-
	092	987	-	2	35	-	-	-	-
	093	16	-	1	5	-	-	-	-
	094	-	-	-	-	-	-	-	-
	101	2	3	94	2	-	-	-	-
	102	105	1,468	12,319	778	303	32	1,300	115
	103	126	1,794	15,255	488	317	27	1,091	157
	104	95	1,095	10,303	187	52	16	545	10
	105	-	20	89	-	-	-	-	-
Area Total		**194,594**	**4,380**	**38,077**	**3,710**	**109,591**	**75**	**2,936**	**3,614**
Total		**304,185**	**4,455**	**41,013**	**7,324**				

* The Area E fishery occurred downstream of Mission Bridge

Table 2. Fisher-independent encounters of sockeye (SK), coho (CO), chum (CM), and chinook (CH) by statistical (stat) week and spatial area for the observer and test fisheries data sources. Stat week 081 is the first week of August. Only stat weeks where fisheries data were available are included in the table.

Mouth to Harrison						Harrison to Sawmill					
Data Source	Stat Week	SK	CO	CM	CH	Data Source	Stat Week	SK	CO	CM	CH
Observer	082	2,145	-	-	15	Qualark	82	426	-	-	11
	083	2,351	1	-	14		83	520	-	-	17
	084	1,767	-	-	25		84	498	-	-	19
	091	1,226	1	-	13		91	524	-	-	17
	092	899	9	-	52		92	395	1	-	13
	093	631	-	-	1		93	151	5	-	6
	104	6	47	689	2		94	402	5	1	-
	105	1	33	826	3		101	258	3	1	-
	Total	**9,026**	**91**	**1,515**	**125**		**Total**	**3,174**	**14**	**2**	**83**
PSC	075	114			6						
Test	081	688			18						
Fisheries	082	1,253			21						
(<5.5 inch)	083	1,287			33						
	084	1,029	1		39						
	091	1,120	1	3	40						
	092	556	15	8	31						
	093	867	16	18	21						
	094	776	28	94	22						
	Total	**7,690**	**61**	**123**	**231**						
Albion	101	6	9	478	17						
Chum	102	5	37	1,462	35						
Gillnet	103	2	20	1,754	11						
	104	-	18	1,508	3						
	105	1	20	1,218	9						
	Total	**14**	**104**	**6,420**	**75**						
Pooled	075	114	-		6						
PSC and	081	688	-		18						
Observer	082	3,398	-		36						
Data	083	3,638	1		47						
	084	2,796	1		64						
	091	2,346	2		53						
	092	1,455	24		83						
	093	1,498	16		22						
	094	776	28		22						
	Total	**16,709**	**72**		**351**						
Pooled	101		9	478	17						
Albion and	102		37	1,462	35						
Observer	103		20	1,754	11						
Data	104		65	2,197	5						
	105		53	2,044	12						
	Total		**184**	**7,935**	**80**						

Table 3. Estimated encounter rates for fisher-reported and fisher-independent data sources by statistical week. Stat week 081 is the first week of August. Only stat weeks where fisheries data were available are included in the table.

	Fisher Reported			Fisher Independent			
Stat Week	Area E Reported	FN EO Reported	FSC Reported	Area E Observer Data	Area E Observer and Test Fishery Data Combined	Test Fishery Data	Qualark
Coho/Sockeye					**Using Cottonwood/Whonnock (<5.5 in mesh)**		
075			0%		0%	0%	0%
081			0%		0%	0%	0%
082	0%	0.00%	0%	0%	0%	0%	0%
083	0.01%		0%	0.04%	0.03%	0%	0%
084	0.00%	0%	0%	0%	0.04%	0.10%	0%
091	0.02%	0.01%	0%	0.08%	0.09%	0.09%	0%
092	0.28%	0.04%	0%	1.00%	1.65%	2.70%	0.25%
093	0.36%		0%	0%	1.07%	1.85%	3.31%
094							1.24%
Coho/Chum					**Using Albion Chum Gillnet**		
101			3.19%				
102			11.0%				
103			11.1%		1.14%	1.14%	
104	3.58%	0.38%	10.2%	6.82%	2.96%	1.19%	
105	3.19%	0.02%	21.5%	4.00%	2.59%	1.64%	

Table 4. Fisher-reported and fisher-independent estimates of coho encounters by statistical week and area for the Area E, FN EO, and FN FSC fisheries. Stat week 081 is the first week of August. Only stat weeks where fisheries data were available are included in the table.

	Mouth to Harrison				Harrison to Sawmill			
Stat Week	Fisher Reported	Observer	Combined	Test Fishery	Fisher Reported	Observer	Combined	Test Fishery
Area E*								
081								
082								
083	14	57	37					
084	17		177	482				
091	54	278	291	305				
092	1,023	3,687	6,075	9,935				
093	638		1,885	3,257				
094								
103								
104	1,279	2,439	1,058	427				
105	798	1,000	649	411				
Total	**3,823**	**7,462**	**10,172**	**14,816**				
First Nations Economic Opportunity Fishery								
081	0	0	0	0	0	0	0	0
082	2	0	0	0	0	0	0	0
083	0	0	0	0	0	0	0	0
084	0	0	30	81	0	0	10	28
091	13	151	158	166	2	68	71	74
092	40	839	1383	2262	10	334	550	900
093	0	0	0	0	0	0	0	0
103	0	0	0	0	0	0	0	0
104	27	487	211	85	0	0	0	0
105	3	518	336	213	0	40	26	16
Area								
Total	**85**	**1,996**	**2,119**	**2,807**	**12**	**442**	**657**	**1,019**
Total	**97**	**2,438**	**2,776**	**3,825**				
Food, Social and Ceremonial Fishery								
075	0	0	0	0	0	0	0	0
081	0	0	0	0	0	0	0	0
082	0	0	0	0	0	0	0	0
083	0	18	11	0	0	7	4	0
084	0	0	1	2	0	0	0	0
091	0	1	1	1	0	0	0	0
092	0	10	16	27	0	0	0	0
093	0	0	0	0	0	0	0	0
094	0	0	0	0	0	0	0	0
101	3	0	2	2	0	0	0	0
102	1468	0	312	312	32	0	33	33
103	1794	0	174	174	27	0	12	12
104	1095	703	305	123	16	37	16	7
105	20	4	2	2	0	0	0	0
Area								
Total	**4,380**	**735**	**824**	**642**	**75**	**44**	**66**	**52**
Total	**4,455**	**779**	**890**	**694**				

* The Area E fishery occurred downstream of Mission Bridge

Table 5. Fisher-reported and fisher-independent estimates of IFC encounters by statistical week and spatial area for the Area E, FN EO, and FN FSC fisheries. 'SK HR' refers to the sockeye harvest rate method, 'nd' indicates no data. Stat week 081 is the first week of August. Only stat weeks where fisheries data were available are included in the table.

	IFC Component Determined by Decay Curve								Direct Estimate of IFC		
	Mouth to Harrison				Harrison to Sawmill				Mouth to Sawmill		
Stat Week	Fisher Reported	Observer	Combined	Test Fishery	Fisher Reported	Observer	Combined	Test Fishery	Qualark 3-Day	Qualark 2-Day	SK HR
Area E*											
081	-		-	-					-	-	
082	-	-	-	-					-	-	
083	7	29	19	-					-	-	67
084	9	-	92	250					-	-	1,318
091	28	144	151	158					-	-	488
092	515	1,868	3,078	5,034					6,884	2,584	1,135
093	311	-	918	1,586					3,488	5,022	44
094	-	-	-	-					-	-	nd
103	-	-	-	-					nd	nd	nd
104	30	58	25	10					nd	nd	nd
105	19	24	15	10					nd	nd	nd
Total	**919**	**2,123**	**4,298**	**7,048**					**10,371**	**7,606**	**3,052**
First Nations Economic Opportunity Fishery											
081					0	0	0	0	-	-	
082	1				0	0	0	0	-	-	
083					0	0	0	0	-	-	
084			15	42	0	0	5	14	-	-	297
091	7	78	82	86	1	35	37	38	-	-	385
092	20	425	700	1,145	5	170	280	459	2,191	823	361
093					0	0	0	0	-	-	nd
103					0	0	0	0	nd	nd	nd
104	1	12	5	2	0	0	0	0	nd	nd	nd
105	0	12	8	5	0	1	1	0	nd	nd	nd
Area Total	**29**	**527**	**810**	**1,280**	**6**	**206**	**323**	**512**	**2,191**	**823**	**1,043**
Total	**35**	**733**	**1,133**	**1,792**					**2,191**	**823**	**1,043**
Food, Social and Ceremonial Fishery											
075	0	0	0	0	0	0	0	0	-	-	
081	0	0	0	0	0	0	0	0	-	-	
082	0	0	0	0	0	0	0	0	-	-	
083	0	9	6	0	0	3	2	0	-	-	29
084	0	0	0	1	0	0	0	0	-	-	4
091	0	0	0	1	0	0	0	0	-	-	1
092	0	5	8	13	0	0	0	0	18	7	2
093	0	0	0	0	0	0	0	0	0	0	
094	0	0	0	0	0	0	0	0	-	-	nd
101	0	0	0	0	0	0	0	0	nd	nd	nd
102	51	0	12	12	1	0	1	1	nd	nd	nd
103	48	0	5	5	1	0	0	0	nd	nd	nd
104	26	17	7	3	0	1	0	0	nd	nd	nd
105	0	0	0	0	0	0	0	0	nd	nd	nd
Area Totals	**127**	**32**	**39**	**35**	**2**	**4**	**4**	**2**	**19**	**7**	**36**
Total	**129**	**36**	**44**	**37**					**19**	**7**	**36**
Grand Total	**1,083**	**2,893**	**5,475**	**8,876**					**12,581**	**8,436**	**4,130**

* The Area E fishery occurred downstream of Mission Bridge

Table 6. Fisher-reported and fisher-independent estimates of IFC mortalities by statistical week and spatial area for the Area E, FN EO, and FN FSC fisheries. 'SK HR' refers to the sockeye harvest rate method, 'nd' indicates no data. Only stat weeks where fisheries data were available are included in the table.

	IFC Component Determined by Decay Curve								Direct Estimate of IFC			
	Mouth to Harrison				Harrison to Sawmill				Mouth to Sawmill			
Stat Week	Fisher Reported	Observer	Combined	Test Fishery	Fisher Reported	Observer	Combined	Test Fishery	Qualark 3-Day	Qualark 2-Day	SK	HR
Area E*												
081												
082	0	0	0	0					0	0		
083	4	18	11	0					0	0		37
084	5	0	55	150					0	0		727
091	17	86	90	95					0	0		269
092	309	1121	1847	3021					4130	1551		627
093	187	0	551	952					2093	3013		24
094	0		0	0					0	0		nd
103	0		0	0					nd	nd		nd
104	18	35	15	6					nd	nd		nd
105	11	14	9	6					nd	nd		nd
Total	**552**	**1,274**	**2,579**	**4,229**					**6223**	**4564**		**1685**
First Nations Economic Opportunity Fishery												
081	0		0	0	0	0	0	0	0	0		
082	1	0	0	0	0	0	0	0	0	0		
083	0	0	0	0	0	0	0	0	0	0		
084	0	0	9	25	0	0	3	9	0	0		164
091	4	47	49	51	1	21	22	23	0	0		212
092	12	255	420	687	3	102	168	275	1314	494		199
093			0	0	0	0	0	0	0	0		nd
103	0	0	0	0	0	0	0	0	nd	nd		nd
104	0	7	3	1	0	0	0	0	nd	nd		nd
105	0	7	5	3	0	1	0	0	nd	nd		nd
Area Total	**17**	**316**	**486**	**768**	**4**	**124**	**194**	**307**	**1314**	**494**		**575**
Total	**21**	**440**	**680**	**1,075**					**1314**	**494**		**575**
Food, Social and Ceremonial Fishery												
075	0	0	0	0	0	0	0	0	0	0		
081	0	0	0	0	0	0	0	0	0	0		
082	0	0	0	0	0	0	0	0	0	0		
083	0	9	6	0	0	3	2	0	0	0		29
084	0	0	0	1	0	0	0	0	0	0		4
091	0	0	0	1	0	0	0	0	0	0		1
092	0	5	8	13	0	0	0	0	18	7		2
093	0	0	0	0	0	0	0	0	0	0		nd
094	0	0	0	0	0	0	0	0	0	0		nd
101	0	0	0	0	0	0	0	0	nd	nd		nd
102	51	0	12	12	1	0	1	1	nd	nd		nd
103	48	0	5	5	1	0	0	0	nd	nd		nd
104	26	17	7	3	0	1	0	0	nd	nd		nd
105	0	0	0	0	0	0	0	0	nd	nd		nd
Area Total	**127**	**32**	**39**	**35**	**2**	**4**	**4**	**2**	**19**	**7**		**36**
Total	**129**	**36**	**44**	**37**					**19**	**7**		**36**
Grand Total	**701**	**1,750**	**3,302**	**5,340**					**7,556**	**5,065**		**2,296**

* The Area E fishery occurred downstream of Mission Bridge

Table 7. Fisher reported catch encounter estimates in the purse seine Demonstration fishery in Kamloops Lake.

Fishery	Week Ending	Gear	Sockeye	Coho	Coho Enc. Rate
Demonstration					
SFC					
Kamloops Lake	Aug-31	Purse Seine	6,444	1	0.02%
	Sep-07	Purse Seine	2,225	-	0.00%
	Sep-14	Purse Seine	8,873	1	0.01%
	Sep-21	Purse Seine	6,014	14	0.23%
	Sep-28	Purse Seine	12,911	37	0.29%
	Oct-05	Purse Seine	95,351	325	0.34%
	Oct-12	Purse Seine	43,533	399	0.91%
	Oct-19	Purse Seine	851	30	3.41%
		Total	**176,202**	**807**	**0.46%**

Table 8. Fisher independent catch encounter estimates in the purse seine Demonstration fishery in Kamloops Lake.

Fishery	Week Ending	Gear	Sockeye	Coho	Coho Enc. Rate
Demonstration					
SFC					
Kamloops Lake	Sep-28	Purse Seine	9,007	12	0.13%
	Oct-05	Purse Seine	8,006	44	0.55%
	Oct-12	Purse Seine	5,738	89	1.53%
		Total	**22,750**	**145**	**0.63%**

Table 9. Fisher Independent catch encounter estimates in the Lower Thompson River gill net test fishery.

Fishery	Week Ending	Gear	Sockeye	Coho	Coho Enc. Rate
Test Fishery					
Lower Thompson River					
McAbee	Jul-21	Gillnet	22	-	0%
	Jul-28	Gillnet	80	-	0%
	Aug-04	Gillnet	311	-	0%
	Aug-11	Gillnet	750	-	0%
	Aug-18	Gillnet	989	-	0%
	Aug-25	Gillnet	793	-	0%
	Sep-01	Gillnet	523	-	0%
	Sep-08	Gillnet	327	-	0%
	Sep-15	Gillnet	185	-	0%
	Sep-22	Gillnet	-	-	0%
		Total	**3,980**	**-**	**0%**

Table 10. Fisher reported catch encounter estimates in the dip net First Nation FSC fishery in the Lower Thompson River.

Fishery	Week Ending	Gear	Sockeye	Coho	Coho Enc. Rate
FSC					
Lower Thompson River	Sep-21	Dipnet	1,844	-	0%
	Sep-28	Dipnet	5,992	-	0%
	Oct-05	Dipnet	2,079	-	0%
	Oct-12	Dipnet	89	-	0%
	Oct-19	Dipnet	-	-	0%
		Total	**10,004**	**-**	**0%**

Table 11. Fisher independent catch encounter estimates in the dip net Demonstration fishery at Siska Canyon.

Fishery	Week Ending	Gear	Sockeye	Coho	Coho Enc. Rate
Demonstration					
Siska Indian Band					
Fraser Canyon (Siska)	Sep-28	Dipnet	1,557	14	0.89%
	Oct-05	Dipnet	3,224	64	1.95%
		Total	**4,781**	**78**	**1.61%**

Table 12. Expanded Lower Thompson River recreational catch encounter estimates based on fisher reported interview data.

Fishery	Fishery End Date	Gear	Sockeye	Coho	Coho Enc. Rate
Recreational					
Lower Thompson River					
Savona	Oct-19	Rod and Reel	3,316	3	0.09%
Juniper	Oct-19	Rod and Reel	5,445	7	0.14%
Spences Bridge	Oct-19	Rod and Reel	927	-	0.00%
Ashcroft	Oct-19	Rod and Reel	3,090	-	0.00%
		Total	**12,777**	**10**	**0.08%**

Table 13. 2014 Interior Fraser coho post season catch and mortality summary- Interior Fraser River and tributaries.

	Kept	Released **	Mortality
Food Social and Ceremonial			
Directed (terminal)	3	-	3
Bycatch *	265	-	265
Total	**268**	**-**	**268**
First Nations Demonstration			
SFC	37	1,232	160
UFFCA	-	-	-
Siska	-	78	-
Total	**37**	**1,310**	**160**
Recreational			
Other	-	-	-
Lower Thompson	-	14	1
Total	**-**	**14**	**1**
Test Fishery			
Qualark	**6**	**9**	**11**
Grand Total	***311***	***1,333***	***441***

SFC- Secwepemc Fisheries Commission

UFFCA- Upper Fraser Fisheries Conservation Alliance

* 145 of the First Nation FSC bycatch mortalities were captured and retained in the SFC Demonstration Fishery

Gear specific mortality rates identified in the IFMP applied to released catch

Table 14. Terminal harvest rate estimates for lower Fraser gill net fisheries from fisher-dependent and fisher-independent data sources and methods.

	IFC Component Determined by Decay Curve				Direct Estimate of IFC		
Fishery	Fisher Reported	Observer	Combined	Test Fishery	Qualark 3-Day	Qualark 2-Day	SK HR
Area E	2.8%	6.1%	11.6%	17.4%	23.4%	18.9%	7.9%
First Nations Economic Opportunity Fishery	0.1%	2.1%	3.1%	4.4%	4.9%	2.0%	2.7%
Food, Social and Ceremonial Fishery*	0.7%	0.6%	0.6%	0.5%	0.5%	0.5%	0.6%
Grand Total	**3.6%**	**8.4%**	**14.8%**	**22.0%**	**28.8%**	**21.5%**	**11.2%**

*During FSC fisheries Coho retention was permitted, therefore the fisher reported estimate was deemed the highest quality and used in the calculation of terminal harvest rate

Figure 1. Interior Fraser coho migration timing reported by Irvine et al. 1999.