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Pacific Salmon Escapement Estimation Methods and Data for Canada

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Abstract

This document provides an overview of the escapement methodology and management of escapement data for Pacific salmon stocks monitored by the Department of Fisheries and Oceans Canada (DFO). DFO escapement programs are delivered at three levels of intensity: indicator, intensive, and extensive programs, in order of monitoring effort, and accuracy and precision of estimates. Various survey methods have been used and the quality of the data must be considered when interpreting escapement information. Individual spawner survey data records and spawner abundance estimates are stored in the Salmon Escapement Database (NuSEDS) and available for download on the Departmental website.

Introduction

At the 2014 annual meeting of NPAFC, Stock Assessment Working Group members agreed to provide a summary of state of knowledge of escapement data, salmon escapement estimation methods and assumptions associated with each, and preliminary escapement information. The purpose of this paper is to 1) provide an overview of methods used for salmon escapement estimation in British Columbia and the Yukon, 2) provide an overview of escapement data management by DFO as an example for the Stock Assessment Working Group and NPAFC, and 3) provide access to the DFO Pacific salmon escapement data.

The term "escapement" refers to the group of mature salmon that have 'escaped' various sources of exploitation, and returned to freshwater to spawn and reproduce. Salmon escapement assessment is a core activity of DFO in support of conservation and management of salmon stocks for sustainable benefits. Reliable escapement information is required both to determine stock status, as stipulated in Canada's Wild Salmon Policy, and to evaluate the performance of both domestic and the Canada /United States Pacific Salmon Treaty (2009) management actions.

The Stock Assessment Section of Science Branch has the primary responsibility for planning and coordination of escapement assessment programs, and for the management and reporting of the information that is derived from them. Regional escapement assessment programs are delivered by DFO personnel as well as by external partners. To ensure quality and consistency in escapement information the Department has committed to the development and maintenance of survey standards and training. Training encompasses teaching survey methods, safety requirements and procedures, and data recording and processing procedures. Escapement information, whether collected by Departmental staff or external groups, must be reviewed to assess quality and utility of the information.

Escapement Programs

The DFO conducts escapement monitoring for five species of salmon native to British Columbia (B.C.); Sockeye (*Oncorhynchus nerka*), chum (*O. keta*), and pink (*O. gorbuscha*) salmon, Chinook (*O. tshawytscha*), and coho (*O. kisutch*). Escapement programs are delivered at three levels of intensity: indicator, intensive, and extensive programs, in order of monitoring effort, and accuracy and precision of estimates (Tompkins et al. 2012). Both indicator and intensive

programs are delivered at a high level of intensity and provide quantitative estimates of abundance but indicator programs have additional monitoring requirements used for developing estimates of productivity, survival and exploitation rates. Additional biological information such as age and sex composition, body size, fecundity, egg size, genetic diversity, and disease are monitored at indicator systems to help determine the biological status of key populations. Generally, indicator programs are core programs delivered by the agency. Information generated from extensive programs is of lower accuracy and precision, but useful for generating indices of abundance and for discerning trends. Some intensive and extensive programs may be delivered by partners (First Nations, stewardship organizations, etc.).

The collection of salmon escapement information involves a diverse set of methodologies with a range of accuracy and precision from qualitative observations of presence / absence, to indices of total abundance, to relatively accurate counts of spawners (Table 1). The enumeration method used is dependent on the stream characteristics, hydrological conditions, the behavior of the fish, and availability of resources. Visual surveys (walk, snorkel, boat) including aerial counts (helicopter, fixed wing) are commonly used to provide an index of escapement from year to year. Mark recapture studies, fixed weir and fence counts, provide generally escapement estimates of higher accuracy and precision but typically require more effort and resources to implement.

Individual population estimates often go back as far as the early 1950s, but there can be huge variation in the methodology used and their reliability. Estimation quality generally improved over time as regionally consistent escapement survey/analysis methodologies and data standards were applied. Consequently, the method used and quality of the data must be considered when interpreting escapement information.

Data Management

Salmon escapement data constitute important corporate knowledge which must be adequately maintained and accessible. The Salmon Escapement Database (NuSEDS) is the DFO Pacific Region's central database that stores individual spawner survey data records, spawner abundance estimates and the linkages between the two. Annual abundance estimates are maintained by population, as defined by freshwater location and run timing (see Table 2 for attributes and field definitions). NuSEDS is not a spatial database but each population is referenced to the location of the stream mouth. The watershed-coding system provides unique stream identification and incorporates the natural organization, direction, and hierarchical nature of stream channels and their tributaries. The NuSEDS database currently reports salmon spawning observations for 9000+ individual populations but escapement estimates (all levels of survey intensity) are available for 1200+ populations. Examples of the escapement information and summaries available from NuSEDS are provided in Tables 3-5. Table 3 provides the total annual escapement (2005-2014) by Area and species summed over all survey types and populations. Table 4 demonstrates the total escapement for Chinook salmon by survey type for the Fraser Area. Finally, Table 5 provides a summary of the number of Chinook populations surveyed by each survey type by year.

This database contains historic population data starting in 1953 (older data for some rivers exists in other formats). Prior to 1995 a standardized form (BC-16) was used to summarize the estimate of the spawning population size, but the historical database lacked the capacity to describe the

number of observations, individual counts or methods used to estimate the abundance of the population. In 1995, responsibility for salmon enumeration was moved to the DFO Science section. At that time, the database was re-written to include descriptive information for each abundance estimate, providing underlying data and the estimation method(s). Many of the historic estimates prior to 1995 are labeled Unspecified Returns because the database was limited to storing one estimate for any given stock. As time and resources permit these data are being replaced with more accurate categorization. With the introduction of the Wild Salmon Policy (2005), individual populations within NuSEDS can now be grouped by Conservation Unit.

Currently survey information is captured on three forms. Field surveyors complete a Stream Inspection Log (SIL) each time a stream is inspected. Factors affecting escapement estimates such as the method of inspection, water conditions, water level and water clarity are reported together with the actual number of fish seen and the estimated number in the stream. At the end of the spawning season, an annual report of salmon streams and spawning populations (SEN) is compiled from the individual stream visits. A third form, the Stream Narrative, captures significant information on a stream important for future surveys, assessments, development applications, etc. These forms are forwarded to the Escapement Data Unit, at the Pacific Biological Station (PBS) for entry in NuSEDS.

It should be noted that over time there have been major variations in coverage and in systematic retrieval of observations from surveys for many streams in British Columbia and the Yukon. Observations pertaining to many non-environmental events (e.g. changes in basic enumeration method or annual effort) affecting year to year changes in the reliability of escapement estimates are often unavailable for historical escapement reports. Thus, comparison of annual estimates within and between streams must be approached with caution, depending on the application under consideration. Missing records may signify either that no data exist or that none have been received. Further, recent year survey data entry may be incomplete, and historic estimates under review are subject to revision. Users wishing further information about the database are advised to seek additional expert advice from appropriate Stock Assessment Division personnel regarding the relative accuracy and consistency of a given set of abundance estimates.

Access to the DFO NuSEDS database and salmon escapement information is readily available through the internet by the link below:
http://open.canada.ca/data/en/dataset/c48669a3-045b-400d-b730-48aafe8c5ee6
Auxiliary files provide NuSEDS field definitions and background information.

References

Tompkins, A., N. Komick and M. Thiess. 2012. Salmon Assessment in British Columbia and Yukon. NPAFC Doc. 1431. 13 pp. Fisheries and Oceans Canada. Available at http://www.npafc.org).

Table 1. NuSEDS salmon escapement estimate classification type.

Estimate Type	Survey Method(s)	Analytical Method(s)	Reliability (within stock comparisons)	Units	Accuracy	Precision	Documentation
Type-1, True Abundance, high resolution	total, seasonal counts through fence or fishway; virtually no bypass	simple, often single step	reliable resolution of between year differences >10% (in absolute units)	absolute abundance	actual, very high	infinite i.e.+ or - zero%	detailed SIL(s), SEN, field notes or diaries, published report on methods
Type-2, True Abundance, medium resolution	high effort (5 or more trips), standard methods (e.g. mark-recapture, serial counts for area under curve, etc...)	simple to complex multi-step, but always rigorous	reliable resolution of between year differences >25% (in absolute units)	absolute abundance	actual or assigned estimate and high	actual estimate, high to moderate	detailed SIL(s), SEN, field notes or diaries, published report on methods
Type-3, Relative Abundance, high resolution	high effort (5 or more trips), standard methods (e.g. equal effort surveys executed by walk, swim, overflight, etc.)	simple to complex multi-step, but always rigorous	reliable resolution of between year differences >25% (in absolute units)	relative abundance linked to method	assigned range and medium to high	assigned estimate, medium to high	detailed SIL(s), SEN, field notes or diaries, published report on methods
Type-4, Relative Abundance, medium resolution	low to moderate effort (1-4 trips), known survey method	simple analysis by known methods	reliable resolution of between year differences >200% (in relative units)	relative abundance linked to method	unknown assumed fairly constant	unknown assumed fairly constant	complete SEN or equivalent with sufficient detail to verify both survey and analytical procedures
Type-5, Relative Abundance, low resolution	low effort (e.g. 1 trip), use of vaguely defined, inconsistent or poorly executed methods	unknown to ill defined; inconsistent or poorly executed	uncertain numeric comparisons, but high reliability for presence or absence	relative abundance, but vague or no i.d. on method	unknown assumed highly variable	unknown assumed highly variable	incomplete SEN, only reliable to confirm estimate is from an actual survey
Type-6, Presence or Absence	any of above	not required	moderate to high reliability for presence/absence	(+) or (-)	medium to high	unknown	any of above sufficient to confirm survey and reliable species i.d.

Table 2. NUSEDs database attributes and field definitions.

Field Name	Field Definition
AREA	This is the subdistrict. In most cases subdistricts are the same as statistical areas. They mainly differ for streams that eventually drain into the Fraser and for large areas that have been split up and thus have a/b/c... designations. E.g. Statistical area 03 has two subdistricts 3A and 3B.
WATERBODY	This is the name of the waterbody or portion of a waterbody that bounds the population as shown on any given SEN.
GAZETTED_NAME	Provincially recognized name for the waterbody.
LOCAL_NAME_1	Commonly known name for the waterbody.
LOCAL_NAME_2	Second most commonly known name for the waterbody.
WATERSHED_CDE	45 digit hierarchical provincial code unique to the waterbody and its watershed.
WATERBODY_ID	This is a combination of 5 digits that uniquely identify a GIS polygon and four characters that uniquely describe a provincial watershed group.
RAB_CDE	Discontinued Resource Analysis Branch Code unique to each waterbody.
POPULATION	Default naming originates from previous databases as a concatenation of stream name, subdistrict, species and run type. This is the most important piece of data that all the other SEN data fields refer to.
RUN_TYPE	Run_Type indicates the run timing for different runs within the same season. In some cases, the runs may be well documented enough to label them as something like "Spring" vs. "Summer" or "Early vs. "Late". But in other cases there is no documentation other than to indicate that there are distinct runs within a season. In these cases, we used the numeric labelling approach for historic data in order to avoid adding unintentional (and potentially inaccurate) detail.
SPECIES	Species of Fish.
ANALYSIS_YR	This is the year that the estimate is for. Surveys may have continued into the following calendar year.
START_DTT	This is the time stream inspections began e.g. 2000-10-15 means that the first inspection for this season's estimate started on October 15 2000.
END_DTT	This is the time stream inspections ended e.g. 2000-11-15 means that the last inspection for this season's estimate started on November 15 2000.
ESCAPEMENT_ANALYST	Person responsible for estimate(s) on this SEN.
ACCURACY	This is the ability of a measurement to match the actual value of the quantity being measured. Some historical estimates that were imported had reliability data originating from SEDS that may appear here.
PRECISION	This is the ability of a measurement to be consistently reproduced, or put another way, the number of significant digits to which a value has been reliably measured.
INDEX_YN	This indicates whether the estimates are for a portion of the population. This is usually due by purposely limiting enumeration to a portion of the spawning habitat or a portion of the duration of the run.
RELIABILITY	This field was added for the inclusion of historical data from an external source. It is the level of reliability that the person placed in their annual estimate of adults. Since this was only recorded for some historical BC16s it will not be visible in all cases. Values are low, medium low, medium, medium high and high.
ESTIMATE_STAGE	Preliminary SENs are the first drafts of summary estimate documents. Source data may be incomplete and their accuracy has not been verified. Significant changes from Preliminary estimates are probable. Near Final SENs are based on data that have been verified for completeness and accuracy. Further analysis may take place. Final data verification and analysis have not been completed. Minor changes in Near Final estimates are possible. Final SENs are released after all data have been incorporated into the analyses and all verification steps have been completed. Changes are not anticipated.

Field Name	Field Definition
ESTIMATE_CLASSIFICATION	This categorizes estimates based on their levels of accuracy and precision (Type-1 are the most accurate, Type-6 the least accurate). There are three other classifications that belong to SENs whose source data were migrated from the regional MSAccess SILBC16 database (definitions extracted from that user manual). RELATIVE: CONSTANT MULTI-YEAR METHODS and RELATIVE: VARYING MULTI-YEAR METHODS: "This is the case with survey methods restricted to a fraction of the spawning habitat and/or a fraction of the spawning period. There are various types of relative abundance estimates depending on the survey method, the level of standardization of the methods, and the sampling effort. For our purpose we have retained one type based on between-year consistency of the method where there are two levels." NO SURVEY THIS YEAR: "stream was not inspected for that species this year"
NO_INSPECTIONS_USED	This is the number of stream inspection logs that are linked to the SEN or were used in the analysis. E.g. 10 stream inspections and a fixed site survey may have been done in the season, but only 7 stream inspections and the fence counts will be used to produce the annual estimate(s), and only these are linked to the SEN.
ESTIMATE_METHOD	There are several standard methods to choose from. • Addition/Subtraction - simple addition or subtraction to provide an estimate. Should be used in conjunction with activity types Adjustment/Calibration and Summary observations. E.g. a population aggregate, the sum of two or more populations, would require the linking of two or more SENs and straight summation of the estimates. • Multiplication/Division - simple multiplication or division to summary estimates. This method should be used in conjunction with activity type Adjustment/Calibration. E.g. An annual estimate that was arrived at by Peak Live Plus Dead analysis can be adjusted by some factor to make it equivalent to a Time Series estimate that uses AUC calculations. • Area Under the Curve - Combining a series of point estimates for abundance to create an estimate for the annual abundance. This is done by determining the total area under a curve of abundance by time then dividing by the survey life (the average length of time that an individual is available to be observed alive i.e. is still within the survey area and is not dead). • Peak Live Plus Dead - Examine point estimates for abundance, determine the survey when the maximum live count observed; sum the live and dead counts for that survey to create the annual estimate. • Peak Live Plus Cumulative Dead - Examine point estimates for abundance, determine the survey when the maximum live count observed. Sum the live count for that survey with the cumulative total of the dead counts prior to and including that survey to create the annual estimate. • Fixed Site Census - Combining one or more raw observations into a single estimate (e.g. add all daily fence observation SIL to create a single annual estimate). • Mark and Recapture - Petersen - Use capture and re-capture SIL data to determine an abundance estimate with the Petersen calculation. • Mark and Recapture - Jolly-Seber - Use capture and re-capture SIL data to determine an abundance estimate with the Jolly-Seber calculation. • Redd Count - Using counts of redds from SILs and multiplied by a factor such as 2. • Lake Expansion - expanding the dead recoveries by the recovery effort • Cumulative New - N/A
STREAM_ARRIVAL_DT_FROM	This is the start date when the fish first arrive in the water body described on the SEN Details page. Note that the spawn run timings are paired so that Arrival, Start, Peak, and End each have beginning and end date values to represent a date range. The following definition applies to SENs whose source data were migrated from the regional MSAccess SILBC16 database applying mainly to areas 11 to 27, and Fraser chinook/coho, all from 1995 to 2001: "is defined as the month and days (period) that 5% of the fish arrived in the stream. If the number at peak spawning is known, you can identify any of your counts that correspond to 5% of that value. If so the date you made this observation will correspond to the arrival date".
STREAM_ARRIVAL_DT_TO	This is the end date of arriving fish to the water body described on the SEN Details page.
START_SPAWN_DT_FROM	This is the spawning start date for a population for the current season where start means fish are beginning to pair on the spawning grounds, schools of fish may be holding (pools or mouth) and there are very few, if any, carcasses or redds. Fish are generally in the lower sections of the normal spawning area and may be bright with no fungus and have no white-coloured, eroded fins. The following definition applies to SENs whose source data were migrated from the regional MSAccess SILBC16 database applying mainly to areas 11 to 27, and Fraser chinook/coho, all from 1995 to 2001: "month and days (period) when fish are paired and redds are observed".

Field Name	Field Definition
START_SPAWN_DT_TO	This is the end date of the start of spawning period. See above for the definition of this run timing period.
PEAK_SPAWN_DT_FROM	This field records the Spawning Peak date for a population and a given season. Peak means the majority of the fish present are paired and actively spawning with few fish holding. The fish may have fungus or white-coloured, eroded fins. A significant proportion of the spawning grounds should have evidence of redds and the fish should generally be distributed throughout the spawning area. The following definition applies to SENs whose source data were migrated from the regional MSAccess SILBC16 database applying mainly to areas 11 to 27, and Fraser chinook/coho, all from 1995 to 2001: "month and days (period) when the number of fish spawning reached its maximum".
.PEAK_SPAWN_DT_TO	This is the end date of the peak of spawning period. See above for the definition of this run timing period.
END_SPAWN_DT_FROM	This field records the Spawning End date for a population and a given season. End means very few fish are on the spawning grounds, few unspawned fish are holding and there are lots of carcasses. The remaining fish will likely occupy the upper reaches of the spawning area. The following definition applies to SENs whose source data were migrated from the regional MSAccess SILBC16 database applying mainly to areas 11 to 27, and Fraser chinook/coho, all from 1995 to 2001: "month and days (period) when virtually all fish have spawned in the stream".
END_SPAWN_DT_TO	This is the end date of the end of spawning period. See above for the definition of this run timing period.
ADULT_PRESENCE	Values are present if adults were observed, none observed if no adults were observed during the stream inspections, not inspected if adults were not looked for, unknown if it is not known whether adults were observed during inspections or not.
JACK_PRESENCE	Values are present if jacks were observed, none observed if no jacks were observed during the stream inspections, not inspected if jacks were not looked for, unknown if it is not known whether jacks were observed during inspections or not.
MAX_ESTIMATE	Is the maximum estimated number taken from: NATURAL_ADULT_SPAWNERS, NATURAL_JACK_SPAWNERS, NATURAL_SPAWNERS_TOTAL, ADULT_BROODSTOCK_REMOVALS, JACK_BROODSTOCK_REMOVALS, TOTAL_BROODSTOCK_REMOVALS, OTHER_REMOVALS, TOTAL_RETURN_TO_RIVER, UNSPECIFIED_RETURNS.
NATURAL_ADULT_SPAWNERS	All salmon that have reached maturity, excluding jacks (jacks are salmon that have matured at an early age).
NATURAL_JACK_SPAWNERS	These are fish that have matured at an early age and are considered precocious. They are usually distinguished from adults by their small size.
NATURAL_SPAWNERS_TOTAL	This is the sum of adult and jack natural spawners.
ADULT_BROODSTOCK_REMOVALS	All salmon that have reached maturity, excluding jacks (jacks are salmon that have matured at an early age) that have been removed from the natural environment for artificially pairing and incubation of progeny in an artificial environment for at least some portion of the incubation period. Eg. hatchery broodstock.
JACK_BROODSTOCK_REMOVALS	these are fish that have matured at an early age and are considered precocious that have been removed from the natural environment for artificially pairing and incubation of progeny in an artificial environment for at least some portion of the incubation period. Eg. hatchery broodstock.
TOTAL_BROODSTOCK_REMOVALS	This is the sum of adult and jack broodstock removals.
OTHER_REMOVALS	Sexually maturing fish that have returned to the artificial / natural spawning grounds and were removed from the natural environment, by humans, prior to spawning for purposes other than collection of gametes. This includes in-river fisheries and surplus hatchery removals (fish that were initially removed for enhancement purposes but were not used for enhancement).
TOTAL_RETURN_TO_RIVER	The complete accounting of sexually maturing fish that have returned to the freshwater environment. Total return to river = natural spawners + artificial spawners (e.g. hatchery broodstock) + other removals (harvest, ESSR).

Field Name	Field Definition
UNSPECIFIED_RETURNS	Sexually maturing fish that have returned to the freshwater environment. It is unknown whether this estimate refers to adults or adults and jacks, or whether it refers to the total return to river or a portion of. This is the field occupied by nuSEDS V1.0 estimates and some imported data. It is not a category available to estimates created after 2001.
ENUMERATION_METHOD1	The enumeration method used to observe fish. Values are: Bank Walk, Based on Angling Catch, Biologist/Working Group, Boat, Broodstock Removal, Dead Pitch, Electronic Counters, Electroshocking, Enumeration by Hatchery, Fence, Fixed Wing Aircraft, Float, Helicopter, Hydroacoustic Station, Other, Peak Live and Dead Count, Redd Counts, Snorkel, Spot Checks, Stream Walk, Strip Counts, Tag Recovery, Trap, Walk.
ENUMERATION_METHOD2	If more than one enumeration method was used.
ENUMERATION_METHOD3	If more than two enumeration methods was used.
ENUMERATION_METHOD4	If more than three enumeration methods was used.
ENUMERATION_METHOD5	If more than four enumeration methods was used.
ENUMERATION_METHOD6	If more than five enumeration methods was used.
NATURAL_ADULT_FEMALES	Fraser River Specific field- All female salmon that have reached maturity, excluding jills (jills are female salmon that have matured at an early age).
NATURAL_ADULT_MALES	Fraser River Specific field- All male salmon that have reached maturity, excluding jacks (jacks are male salmon that have matured at an early age).
EFFECTIVE_FEMALES	Fraser River Specific field- Is the number of females estimated to have successfully spawned. This is calculated by multiplying the total female estimate (less removals eg. for fecundity estimation) by the weighted percent spawn.
WEIGHTED_PCT_SPAWN	Fraser River Specific field-Created to accommodate Fraser Sockeye data. This is based on evaluations of the success of spawn (fully spawned - 100%; partially spawned - 50%; unspawned - 0%) of individual female carcasses. A daily weighted percent spawn is applied to the total female recoveries for that day. The total effective females across the recovery period are summed and divided by the total female recoveries to calculate the overall weighted percent spawn.
OTHER_ADULT_REMOVALS	created for South Coast (Somass System Sockeye).
OTHER_JACK_REMOVALS	created for South Coast (Somass System Sockeye).
TOT_ADULT_RET_RIVER	created for South Coast (Somass System Sockeye).
TOT_JACK_RET_RIVER	created for South Coast (Somass System Sockeye).
JUV_PRES_TYP	An indication of whether smolts or fry were present during the inspection. This field is from Historical Data (pre-2001) from Aeas 11 to 27, and Fraser chinook/coho, all from 1995 to 2001.
ACT_ID	This is the primary key for the SEN.
POP_ID	Population ID.
SPC_ID	Species ID.
GFE_ID	Stream ID (Geo_Feature ID).
CREATED_DTT	The date the SEN was created.
UPDATED_DTT	The date the SEN was updated.
YLAT	Location of the mouth of the waterbody if flowing, or the centroid if not.
XLONG	Location of the mouth of the waterbody if flowing, or the centroid if not.

Table 3. Total escapement estimates by all survey types for 2005-2014 by species and Area reported by DFO NuSEDs database.

AREA	SPECIES	Return Year*									
		2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Yukon	Chinook	48,488	41,704	1,052	396						
	Chum	624,500	249,279	33,750	20,055						
Trans-boundary	Chinook	119,578	56,728	19,139	5,839	1,571	2,356	1,670	693	1,261	
	Coho	147,699	136,686	84,110	5,422	424	2,365	2,119	1,272	7,322	
	Sockeye	274,436	505,771	141,835	279		18,960	21,389	17,694	3,902	
Haida Gwaii	Chinook	5,197	5,100	21	78	15	9				
	Chum	177,959	185,924	68,016	123,130	214,138	101,093	124,270	194,174	49,350	30,485
	Coho	18,875	21,656	12,642	10,310	27,149	17,892	20,296	10,258	220	50
	Pink	70,094	452,078	36,871	900,163	31,433	2,287,818	68,745	1,382,447	20	40,450
	Sockeye	12,432	44,249	16,116	18,812	20,963	41,680	38,226	34,172		
North Coast	Chinook	32,218	44,614	41,138	42,542	41,234	45,158	37,162	36,115	14,761	18,514
	Chum	77,827	136,844	45,072	29,810	64,316	34,896	133,663	164,721	32,011	69,649
	Coho	122,813	86,758	44,842	59,980	141,261	71,298	54,598	74,198	47,425	78,645
	Pink	3,794,560	530,627	2,673,922	325,017	5,907,647	866,433	874,733	1,442,906	3,717,475	3,681,123
	Sockeye	874,898	1,351,733	1,176,394	1,039,476	873,871	858,119	1,121,279	1,296,998	104,729	365,245
Central Coast	Chinook	25,960	34,700	19,180	15,894	16,630	17,130	14,575	9,770	29,277	24,840
	Chum	434,254	408,938	266,577	127,257	214,255	151,941	514,078	319,493	424,954	227,234
	Coho	52,252	24,753	33,996	12,551	43,113	23,896	30,325	17,263	26,027	20,578
	Pink	1,884,721	317,210	1,382,285	394,727	2,188,213	275,721	798,818	271,936	1,607,316	317,900
	Sockeye	122,910	92,921	80,532	66,531	62,703	79,326	282,674	93,879	162,468	140,358
Inside South Coast	Chinook	49,094	57,243	47,224	35,531	40,051	39,339	42,221	32,108	31,513	22,976
	Chum	513,402	754,046	620,043	497,760	496,110	321,155	863,291	892,747	653,168	194,745
	Coho	54,334	55,968	88,130	59,800	145,170	98,009	94,440	80,023	129,581	18,219
	Pink	587,777	573,222	716,595	540,192	2,597,969	1,269,680	578,253	2,676,367	2,651,249	57,880
	Sockeye	37,972	52,211	29,071	42,598	26,986	148,229	163,163	82,752	77,899	482
	Steelhead				194	253	199	242	269		
West Coast Vancouver Island	Chinook	79,993	121,430	49,324	65,376	38,837	38,825	50,528	28,423	132,041	42,990
	Chum	802,638	331,601	314,020	163,449	219,283	201,961	576,022	407,210	229,511	233,965
	Coho	52,295	29,500	30,788	44,737	83,403	60,449	77,571	48,539	102,129	36,841
	Pink	22	7	25	22	194	105	155	202	427	8
	Sockeye	352,570	208,214	163,334	213,542	443,182	895,368	923,210	168,790	5,936	351
	Steelhead		137			35					
Fraser	Chinook	137,268	174,062	182,418	126,175	231,210	255,832	247,659	36,710	34,689	83,544
	Chum	36,282	43,710	23,207	47,946	29,119	14,601	50,169	35,716	31,661	
	Coho	13,428	7,576	45,347	11,065	22,501	39,498	28,231	42,858	46,799	15,875
	Sockeye	2,732,595	1,476,561	803,349	813,091	1,017,071	4,204,634	2,353,158	920,713	2,327,206	
Total Escapement		14,371,341	8,613,761	9,290,365	5,859,747	15,240,310	12,483,975	10,186,933	10,821,416	12,682,327	5,722,947

- Missing records may signify either that no data exist or that none have been received. Missing values in recent years are likely incomplete.

Table 4. Total escapement estimates for Fraser River Chinook salmon by survey classification type.

ESTIMATE CLASSIFICATION TYPE	Return Year									
	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
1 TRUE ABUNDANCE	4,801	2,919	181		1,408	3,500	2,101	4,177	2,678	14,348
2 TRUE ABUNDANCE	96,919	60,422	112,334	44,990	156,423	114,061	145,406	0		
3 RELATIVE ABUNDANCE	1,143	54,022	48,966	49,019	27,570	100,153	69,476	2,424	2,520	6,006
4 RELATIVE ABUNDANCE	34,405	55,307	20,309	32,166	45,809	37,891	30,348	30,109	29,489	63,190
5 RELATIVE ABUNDANCE		1,234	628			2			2	
6 PRESENCE-ABSENCE										
7 UNKNOWN		158			0	225	328	0		
Total Chinook Escapement	137,268	174,062	182,418	126,175	231,210	255,832	247,659	36,710	34,689	83,544

Table 5. The number of Fraser River Chinook salmon populations surveyed by classification type by year.

ESTIMATE CLASSIFICATION TYPE	Return Year									
	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
1 TRUE ABUNDANCE	3	2	1		2	3	2	2	3	2
2 TRUE ABUNDANCE	2	1	1	1	1	1	1	1		
3 RELATIVE ABUNDANCE	6	7	4	8	13	12	16	6	12	7
4 RELATIVE ABUNDANCE	41	37	42	61	58	56	56	59	50	60
5 RELATIVE ABUNDANCE		6	5			1			1	
6 PRESENCE-ABSENCE	1				2				2	1
7 UNKNOWN	5	4			4	9	5	7	6	6
Total Populations	58	57	53	70	80	82	80	75	74	76