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Extended Time-series of Catch and Escapement Estimates for Skeena Sockeye, Pink, Chum, Coho and Chinook Salmon Conservation Units

Prepared for:

Pacific Salmon Foundation

Prepared by:

Karl K. English

LGL Limited
environmental research associates
9768 Second Street
Sidney, BC, V8L 3Y8

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INTRODUCTION

This document provides a brief summary of the methods used to expand the time series of catch, escapement and exploitation rate estimates from the 1980-2010 estimates (English et al. 2012) back to 1960 for Skeena sockeye Conservation Units (CUs) and 1954 for Skeena pink, chum and coho CUs. Exploitation rates for Skeena Chinook CUs are not available prior to 1984 so the time series for Skeena Chinook was not expanded beyond that reported in English et al. (2012).

An earlier version of this document was provided in July 2012 with our submission of the file "TRTC_Area4_30July2012.xlsm" containing the escapement, catch and run size estimates from the preliminary analyses. The preliminary results were reviewed by DFO personnel in September 2012 and no changes were proposed to the analyses conducted for sockeye, pink or coho. Several adjustments were suggested and made to the procedures used to produce the exploitation rate estimates for Area 4 chum salmon. The chum salmon section of the July 2012 document was modified in October 2012 to accompany the revised estimates provided in "TRTC_Area4_10Oct2012+plots.xlsm". The latest version of the estimates for each species was submitted to PSF and DFO in late January 2013 as a series of workbooks (one for each species) with estimates by return year and brood year tables for each CU. An additional file "TRTC_Area4_14Feb2013+plots+FD.xlsm" contains the estimates by calendar year in the format used to produce the figures for each Skeena CU that have been attached to this report (Appendices A-F).

A list of all the Skeena CUs and those included in our analysis is provided in Appendix G. The streams associated with each CU and those used as escapement indicator streams can be found in a data file named "NCCC_Streams1950-2010_2Nov2012.xls". The "NC Streams" worksheet in this file contains all the meta data for each stream along with the 1950-2010 escapement estimates for each stream organized by species. The "Data Fields" worksheet contains definitions for each data field and source for the information in each data field.

The estimates of total spawners and subsequent returns (recruits) by brood year are provided in a file named "SR_Area04_1Feb2013+FD.xlsx". These are the values used in the stock-recruit analysis reported in Korman and English (2013). This file also contains the average age composition estimates for each CU and the year-specific age composition estimates for Babine sockeye CUs and the Kalum-late Chinook CU.

Sockeye Salmon

The estimates for Skeena sockeye were derived by combining the results from Northern Boundary Sockeye Run Reconstruction (NBSRR) model (English et al. 2004; Alexander et al. 2010; in prep.) with exploitation rate estimates for 1960-97 prepared by Les Jantz. Steve Cox-Rogers provided a table originally prepared by Les Jantz with 1960-97 escapement, catch, run size and exploitation rate (ER) estimates for the aggregate returns of sockeye to the Skeena watershed. The Jantz estimates for 1982-1997 were compared with those from derived from the NBSRR model. The ERs estimated by Jantz were consistently larger than those derived from the NBSRR model due largely to lower escapement estimates in the Jantz analysis. The escapement estimates used in the NBSRR analysis were 106-123% (average 111%) larger than the Jantz escapement estimates for 1982-97. This was expected since the total escapement estimates used in the NBSRR model included an expansion factor of 3.6 that was applied to all non-Babine escapement estimates. The Jantz analysis did not apply any expansion factor to the reported escapements for non-Babine sockeye stocks. After adjusting the Jantz escapement estimates to match those used in the NBSRR model, the revised Jantz ER estimates were within 3% of those estimated using the NBSRRM model. In order to make the pre-1982 estimates consistent with those for 1982-

2010, we have increased the 1960-1981 escapement estimates by 111%. The above process provides a fairly consistent time-series of ERs for Skeena sockeye from 1960-2010.

The next step was to derive ERs for each Skeena sockeye CU using a modified version of the NBSRR model and a new Skeena Sockeye In-River (SSIR) model (English et al. 2013) that incorporate information on the relative run timing for each of the Skeena sockeye CUs (Table 1). The Ecstall/Lower sockeye CU is below the Tyee test fishery, therefore, no comparable run-timing data is available for this CU. However, Ecstall/Lower CU timing and exploitation rates should be similar to those estimated for the Johnston Lake sockeye CU. Both of these models use daily abundance estimates from the Tyee test fishery to define the run timing for the aggregate Skeena sockeye stock. DNA samples obtained from sockeye caught in the Tyee test fishery from 2000-10 were used to derive river entry timing for 20 sub-stocks of Skeena sockeye (Cox-Rogers 2012). The difference between the run timing estimate for each sub-stock and the median timing for all sockeye at Tyee was used to define the “offset” (the number of days before or after the median date) for each sub-stock. The harvests of each sub-stock in marine fisheries were calculated using these offsets and the assumption that all Skeena sub-stocks were vulnerable to all marine fisheries depending on the timing of these fisheries. For example: if the relative run timing for a specific sub-stock was early (e.g. -21 days for Lakelse sockeye) and the reconstructed daily harvest rates in marine fisheries were low early in the fishing season, the marine exploitation rates for this early run sockeye stock would be low relative to other sub-stocks with run timing that aligned with higher harvest rates in marine fisheries. A similar approach was used in the SSIR model to estimate stock-specific harvest rates for in-river fisheries except the sub-stocks were only vulnerable to fisheries conducted downstream of their spawning location within the Skeena watershed. The in-river harvest rates (IRHR) were combined with the marine ERs (MER) using the following formula to compute the Canadian ERs (ER_{CDN}) and Total ERs (ER_{Total}) for each sub-stock:

$$ER_{Total} = MER_{Total} + (1-MER_{Total}) * IRHR$$

$$ER_{CDN} = MER_{CDN} + (1-MER_{Total}) * IRHR$$

The CU-specific ERs were combined with escapement estimates to compute the total run size and catch estimates for each CU. For those CUs where sockeye escapement was estimated using a counting fence (i.e. Babine, Kitwancool 2000-2010, Damshilgwit, and Skeena River High Interior – Jackson Creek) the expansion factor for observer efficiency was set to 1.0. For all other CUs where escapements were estimated from visual surveys, the observer efficiency expansion factor was set to 2.0.

Note the new NBSRR model now contains an automated procedure for running all years and an Excel file named “Sockeye Exploitation Rate Summary ddmmmyy.xls” contains a macro to extract the annual ER estimates for each CU from all the NBSRR model output files.

Table 1. Summary of the migration timing parameters (offsets and SDs) for each Skeena sockeye sub-stock used in the NBSRRM to estimates marine ERs for sockeye CU, 1982-2009. See Appendix G for the list of CUs from Holtby and Ciruna (2007) and those included in our analysis.

							Source: Cox-Rogers (2012)			
#	Stocks (Geographic CUs)	CUs in Group	Offset (days)	Duration (days)	Default SD (days)	2006 SD (days)	Group Name	Peak Week	Offset (days)	SD (weeks)
1	Kluatantan/Kluayaz	2	-10.5	105	17.5	17.5	Bulkley-Morice	72	-10.5	2.5
2	Motase	1	3.5	92	15.4	15.4	Motase	74	3.5	2.2
3	Sustut/Johanson/Spawning	3	-3.5	84	14.0	14.0	Sustut	73	-3.5	2.0
4	Bear/Azuklotz/Asitika	3	-3.5	84	14.0	14.0	Sustut	73	-3.5	2.0
5	Slamgeesh/Damshilgwit	2	-3.5	84	14.0	14.0	Sustut	73	-3.5	2.0
6	Sicintine	1	-3.5	84	14.0	14.0	Sustut	73	-3.5	2.0
7	Babine W Early[1]	1	-10.5	84	14.0	14.0	Babine WE	72	-10.5	2.0
8	Babine W Middle[2]	1	-3.5	84	14.0	14.0	Babine WM	73	-3.5	2.0
9	Babine W Late[3]	1	10.5	84	14.0	14.0	Babine WL	75	10.5	2.0
10	Babine Pinkut	1	-3.5	84	14.0	17.5	Pinkut	73	-3.5	2.0
11	Babine Fulton	1	3.5	84	14.0	17.5	Fulton	73	3.5	2.0
12	Swan/Stephans/Club	3	-10.5	76	12.6	12.6	Swan+	72	-10.5	1.8
13	Bulkley/Maxan	2	-10.5	105	17.5	17.5	Bulkley-Morice	72	-10.5	2.5
14	Morice/Atna	2	-10.5	105	17.5	17.5	Bulkley-Morice	72	-10.5	2.5
15	Kitwanga	1	3.5	118	19.6	19.6	Kitwanga+	74	3.5	2.8
16	Zymoetz[4]	3	-17.5	59	9.8	9.8	Zymoetz	71	-17.5	1.4
17	Kalum	1	-3.5	105	17.5	17.5	Kalum-Bear	73	-3.5	2.5
18	Lakelse	1	-21.0	80	13.3	13.3	Lakelse+	64	-21	1.9
19	Alastair	1	-14.0	109	18.2	18.2	Alastair	71	-14	2.6
20	Johnston/Ecstall	1	-21.0	80	13.3	13.3	Lakelse+	64	-21	1.9

[1] Babine W Early includes sockeye spawing in non-enhanced tributaries to Babine Lake and in Onerka Lake.

[2] Babine W Middle includes the Tahlo/Morrison CU.

[3] Babine W Late includes the Nilkitkwa Lake CU.

[4] Zymoetz includes three sockeye lake CUs in the Zymoetz watershed (Mcdonell, Aldrich and Dennis).

Pink Salmon

The method used to derive annual ERs for Skeena pink salmon CUs was similar to that previously described in English et al. (2012). Annual harvest rate (HR) estimates from the 1982-95 run reconstruction analyses conducted for northern boundary Pink salmon (Gazey and English 2000) were used to derive the relationship between annual HRs and fishing effort for Skeena Pink salmon in Area 3 and 4 fisheries. The effort-HR relationships for 1982-95 were combined with annual fishing effort for 1954-2010 to produce annual estimates of HRs for the 1954-81 and 1996-2010 periods.

Catch, effort and CPUE estimates for the Area 3 and 4 seine and gillnet fisheries were used to derive a time series of annual effort estimates that account for variability in weekly fishing effort for both seine and gillnet gear during the period when Pink salmon were harvested in these fisheries. This process included the following steps for Area 4 Pink salmon stocks:

1) weekly pink salmon catch estimates from sale slips were combined with fishing effort data (boat-days) from hail data to calculate weekly Pink CPUE for Area 4 fisheries;
2) weekly CPUE was used to determine the period when Pink salmon were most abundant in Area 4;
3) pink salmon catch and effort estimates for the above period were used to compute estimates of annual CPUE for gillnet gear for comparison with annual CPUE estimates for seine gear;
4) the annual ratio of gillnet CPUE to seine CPUE (mean 0.052, 95% bounds ±0.01) was used to convert gillnet effort into seine effort; and
5) Adjust annual effort estimates based on weekly timing, such that fishing effort during the peak migration period for pink salmon would receive higher weighting than fishing effort during other periods. The weekly weights were derived from relative weekly CPUE for gillnet and seine gear.

These adjusted annual effort estimates for Area 3 and 4 fisheries were combined with the HR estimates from Gazey and English (2000) for 1982-95 to define the Effort-Harvest Rate (EHR) relationship for Skeena pink salmon stocks (Figure 1).

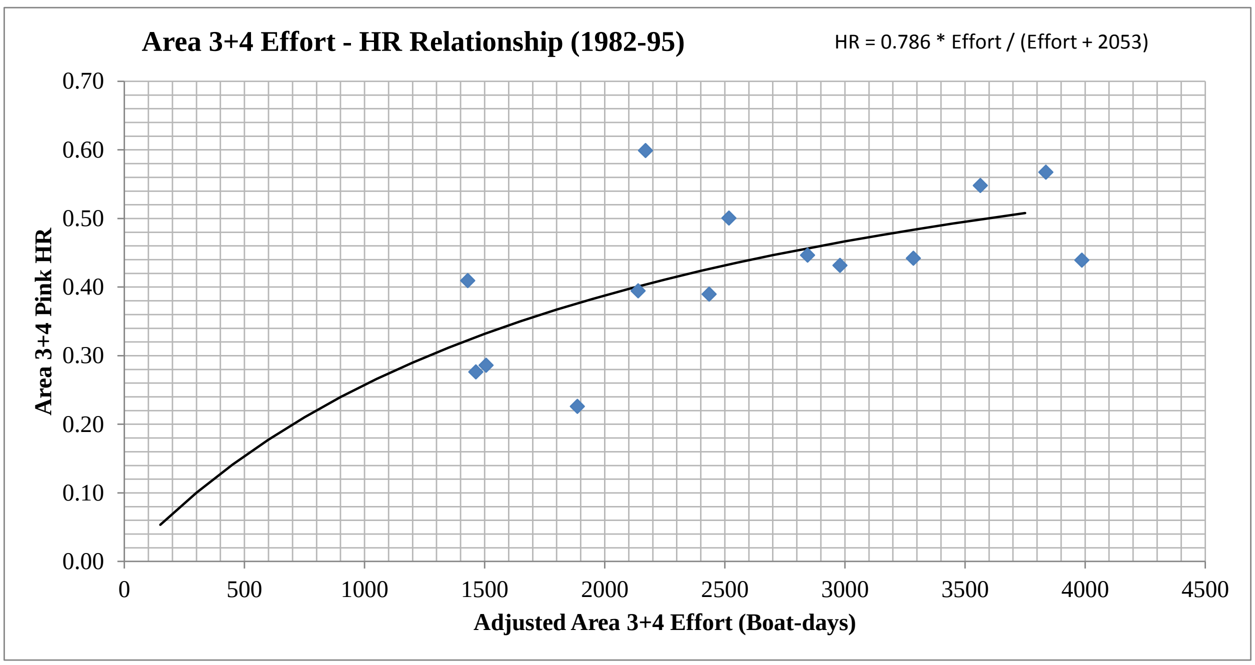

Figure 1. Relationship between the annual Area 3+4 fishing effort and the annual harvest rates estimated for Skeena pink salmon stocks in Area 3+4 fisheries from 1982-95.

The 1982-95 run reconstruction results were used to determine the ratio of annual HRs for other Canadian fisheries to the annual HRs for Area 3 and 4 fisheries. On average, the HRs for other Canadian fisheries were 33% of those for the Area 3 and 4 fisheries and this value was used to estimate the annual HR for other Canadian fisheries for 1954-81. The HR estimates for the other Canadian fisheries from 1996-2010 were assumed to be only 5% of the Area 3 and 4 harvest rates because of the substantial reduction in outside (Area 1 and 5) pink salmon fisheries after 1995.

The ERs for Skeena pink salmon caught in Alaskan fisheries were estimated using the 1982-95 run reconstruction results and effort data of Alaska purse seine fisheries. An Effort-Exploitation Rate (EER) relationship used for Alaskan purse seine fisheries in District 101, 102 and 104 to convert annual fishing effort estimates into ER estimates for Skeena Pink salmon stocks harvested in Alaskan fisheries (English et al. 2012). We did not have access to annual fishing effort for Alaska fisheries data prior to 1982, so we assumed that the Alaska ER for Skeena pink salmon in these years was equal to the average ER for 1982-95 (18%).

Chum Salmon

The procedures used to estimate the annual ERs for Skeena chum salmon were similar to those described above for Skeena pink salmon. This process included the following steps for Skeena chum salmon stocks:

1) Tyee test fishery CPUE data was used to determine the migration period and run timing distribution for Skeena chum salmon in Area 3 and 4 fisheries;
2) Chum salmon catch and effort estimates for the chum migration period (Alaska weeks 27-37) were used to compute estimates of annual CPUE for gillnet gear for comparison with annual CPUE estimates for seine gear;
3) annual estimates of the ratio of gillnet CPUE to seine CPUE for chum were used to convert gillnet effort to seine effort for 1954-2002 (years before chum non-retention regulations);
4) the average annual ratio of gillnet CPUE to seine CPUE for 1982-02 (mean 0.15, 95% bounds $\pm$0.02) was used to convert gillnet effort into seine effort for the years after 2002; and
5) weekly run timing proportions derived from Tyee test fishery data were used to weight the weekly effort estimates and compute adjusted annual effort estimates, such that fishing effort during the peak migration period for chum salmon would receive higher weighting than fishing effort during other periods.

These adjusted annual effort estimates for Area 3 and 4 fisheries for 1982-06 were combined with the HR estimates from the Area 4 Chum model described in English et al. (2012) to define an Effort-Harvest Rate (EHR) relationship for Skeena chum salmon stocks (Figure 2). Three years (1998, 1999 and 2005) were excluded from the data set used to define the relationship because the weekly HRs for Skeena sockeye, used to derive the annual chum HRs, were unusually low in these years. The HR estimates in Figure 2 reflect the average sockeye HRs for the weeks when Skeena chum are present in the Area 3 and 4 fisheries, without any adjustments for non-retention of chum. The resulting EHR relationship was used to derive the annual HR estimates for Area 3 and 4 fisheries using the adjusted annual effort estimates for 1954-1981, 1998, 1999, and 2005. The Area 3-5 chum HRs for 2000-2010, except 2005, were derived from the Area 4 Chum model with adjustments for chum non-retention periods for seine and gillnet fisheries.

The HRs for Skeena chum in Canadian fisheries outside Area 3 and 4 were set equal to the HRs for Skeena sockeye in those fisheries for 1982-1997. The HR estimates for these “Other Canadian” fisheries from 1954-81 was assumed to be 2% based on the average of the HRs estimates for these fisheries from

1982-1990. The HRs for Skeena chum fisheries outside Area 3-5 from 1998-2010 was zero because no fisheries targeting sockeye or chum have been conducted in Canadian waters outside Area 3-5 since 1997.

The ERs for Skeena chum salmon caught in Alaskan fisheries was assumed to be equal to the Alaska ERs for Skeena sockeye from the NBSRR model for 1982-10. In the absence of any other estimates of chum ER for the 1954-81 Alaskan fisheries, we assumed that the Alaska ER for Skeena chum salmon in these years was equal to the average ER for Skeena sockeye in Alaska fisheries for 1982-90 (12%).

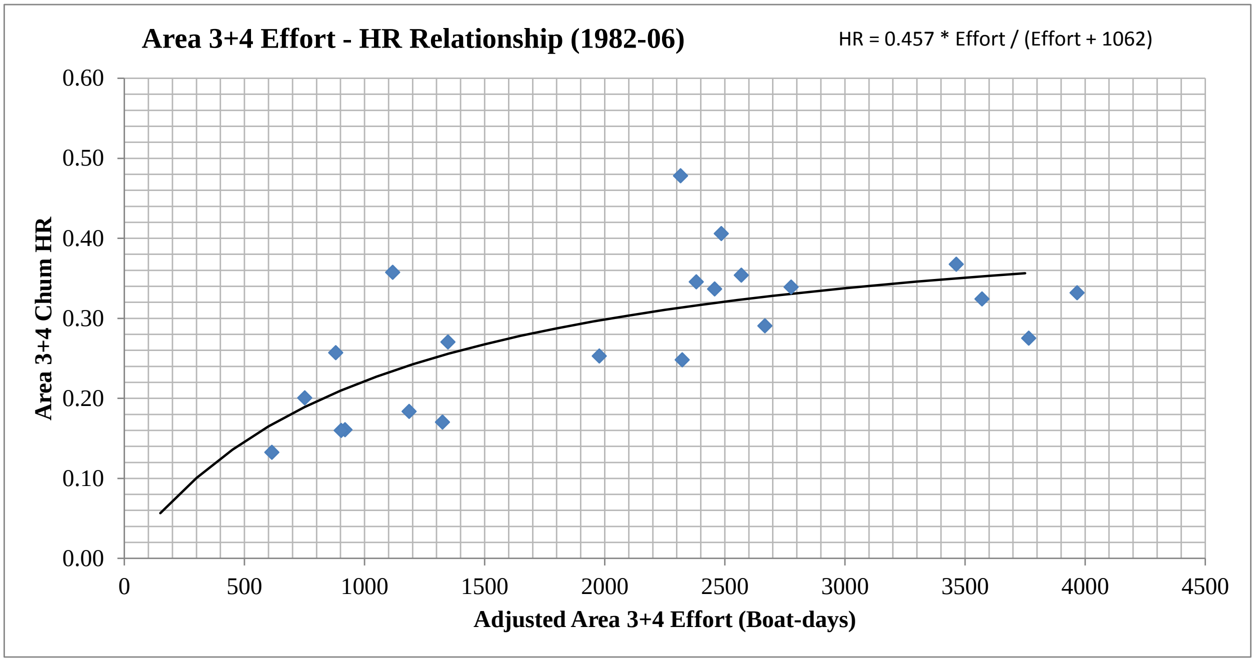

Figure 2. Relationship between the annual Area 3+4 fishing effort and the annual harvest rates estimated for Skeena chum stocks in Area 3+4 fisheries from 1982-06, excluding 1998, 1999 and 2005.

Coho Salmon

The 1954-2010 time-series of ERs for Skeena Coho salmon stocks is comprised of ER estimates for 1954-88 from Holtby (1999) and ER estimates for 1989-2010 derived from CWT data for Toboggan Creek hatchery releases (Dave Peacock, pers. comm.). The CWT data for 1989 and 1990 indicated that Canadian fisheries accounted for 65% of the total ER for Skeena sockeye in these years. This value was used to derive a time series of Canadian ERs from the annual estimates of Total ER reported in Holtby (1999). Holtby (1999) also provided a time-series of escapement estimates for Babine coho for 1946-1998 derived by expanding the Babine fence counts for the portion of the coho run that was not enumerated at the fence. Given the significant uncertainties associated with several of the initial years we used his estimates of the total return from 1954-1998. The 1999-2010 escapement estimates for Babine coho were provided by Dave Peacock and derived from Babine fence counts using methods similar to those reported in Holtby (1999). Babine coho are part of the middle Skeena coho CU, and all of the other estimates of coho escapement to streams in this CU are derived from visual surveys that tend to significantly underestimate the actual escapement of coho. Consequently, our escapement estimate for the Middle Skeena coho CU is comprised of annual estimates for Babine coho combined with annual estimates for all non-Babine coho streams derived using our standard indicator stream approach with an observer efficiency expansion factor of 3.0 (English et al. 2012). Separate estimates for Babine and non-Babine coho streams within the Middle Skeena coho CU are also provided.

Chinook Salmon

The estimates for Skeena Chinook built on the work completed in June 2008 as part of the Skeena Independent Science Review Panel process (Walters et al. 2008). The Skeena Chinook time series started in 1984 with the initiation of a rigorous mark-recapture program for estimating the escapement for Kitsumkalum Chinook. These estimates were combined with those from the Babine fences, and visual surveys of the Bear, Kispiox, and Morice rivers to produce an annual index of the Chinook escapement for the Skeena watershed. This index was expanded to represent the entire Skeena using decadal averages of the portion that these indicator streams represented of the total for all Skeena Chinook spawning areas. Estimates of harvest for marine fisheries were derived by expanding CWT return data for Kitsumkalum Chinook. Estimates for Skeena River Chinook fisheries were derived from First Nation and recreational catch monitoring programs. These harvest estimates were combined to derive the Canadian and Total ERs for Skeena Chinook.

Escapement estimates for each of the Chinook CUs within the Skeena watershed were derived using nuSEDS data and the indicator stream method described in English et al. (2012). This method uses three factors to convert the available data for indicator streams into an estimate of the total annual escapement for a CU. The first factor adjusts for any indicator streams not surveyed in a given year. The second factor expands the total escapement for indicator streams to account for escapement to non-indicator streams within a CU. The third factor is used to account for the tendency to underestimate the “true” escapement with visual survey techniques are used. In the absence of direct measures of this underestimation bias for each Skeena Chinook CU, we have used an expansion factor of 1.3 for all Skeena Chinook CUs where the estimates for indicator stream were derived from visual survey techniques. No expansion was applied to the escapement estimates for Kitsumkalum late-run CU where escapement has been estimated using intensive mark-recapture methods since 1984. The catch estimates for each Skeena Chinook CU were derived using the ERs derived for the Skeena Chinook aggregate. Chinook CUs which enter the Skeena River early are believed to avoid most marine and all in-river fisheries and were assigned ERs that were 10% of the ERs for the Skeena Chinook aggregate. All other Chinook CUs were assigned ERs equivalent to those for the Skeena Chinook aggregate.

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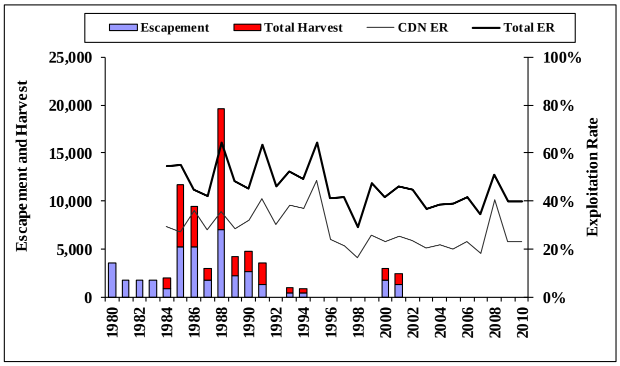
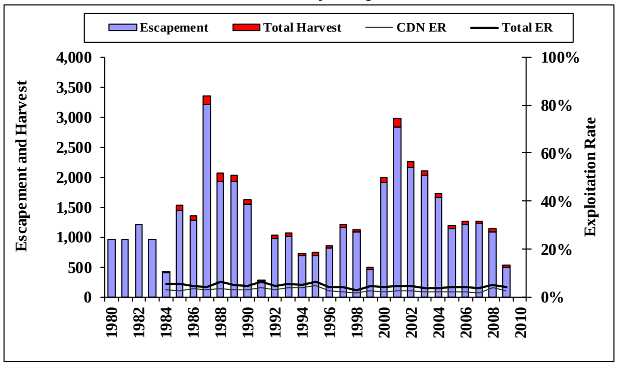
Appendix A - Area 4 Chinook

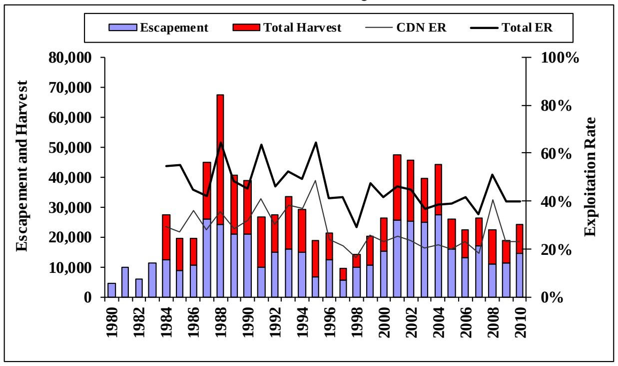
Ecstall



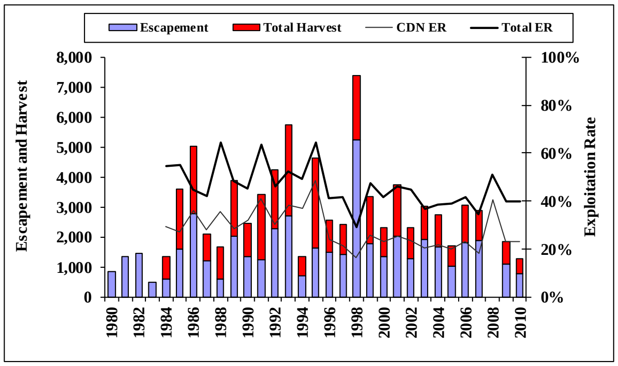
Kalum-early timing



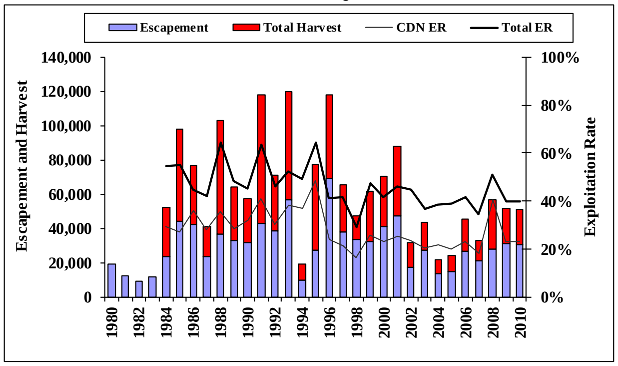
Kalum-late timing



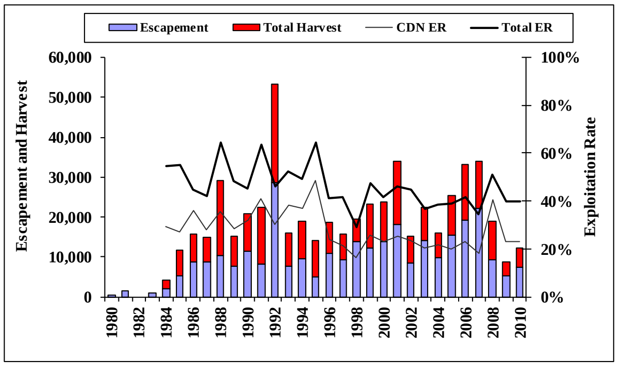
Lower Skeena



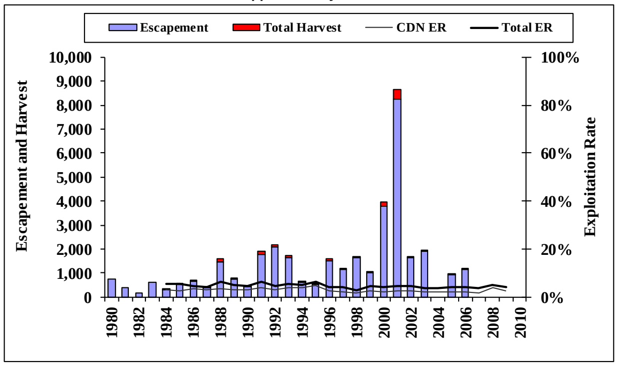
Middle Skeena-large lakes



Middle Skeena-mainstem tributaries

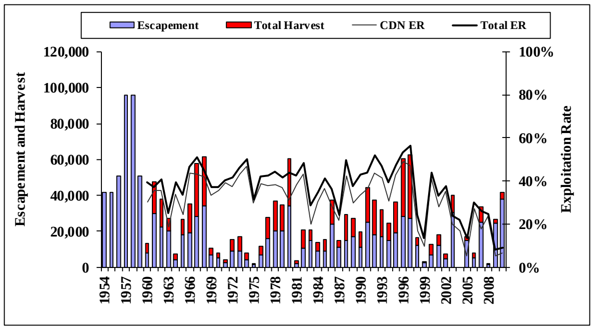


Upper Bulkley River

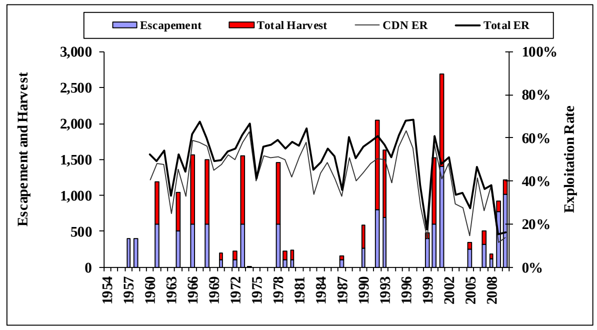


Appendix B - Area 4 Sockeye

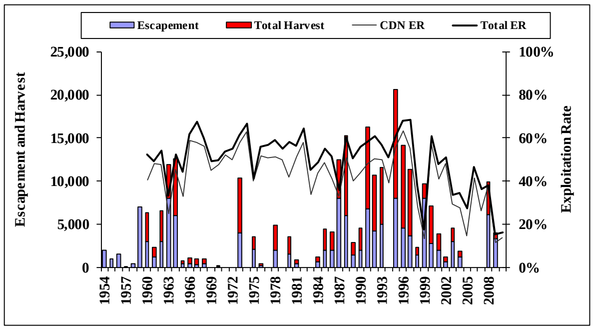
Alastair



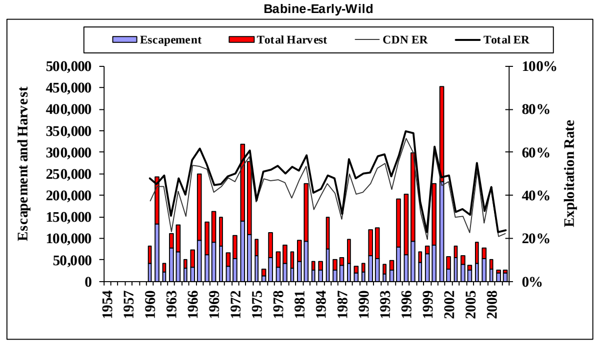
Asitika



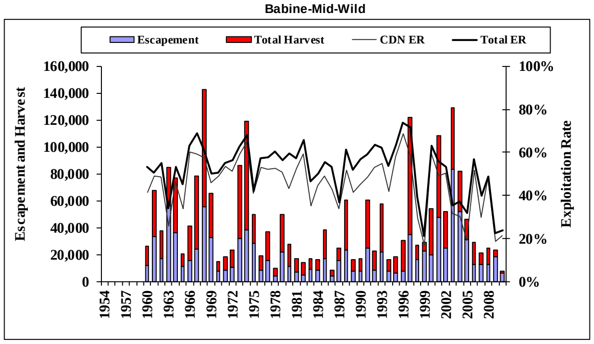
Azuklotz



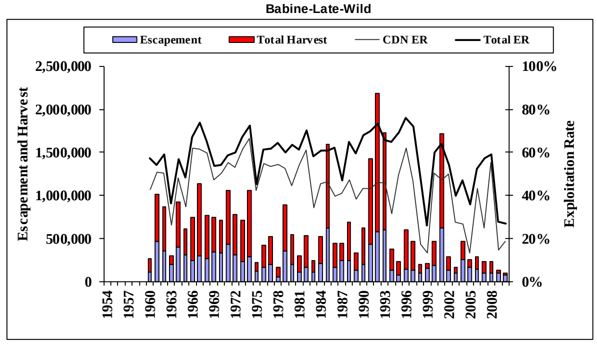
Babine-Early-Wild



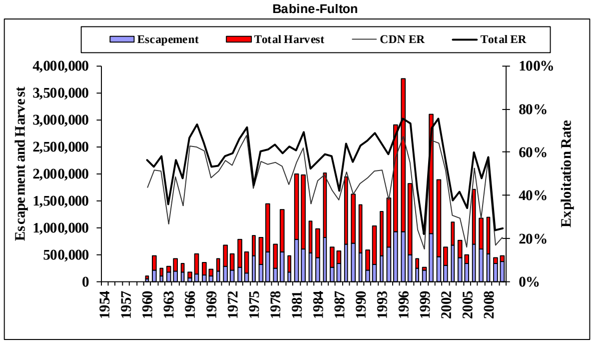
Babine-Mid-Wild



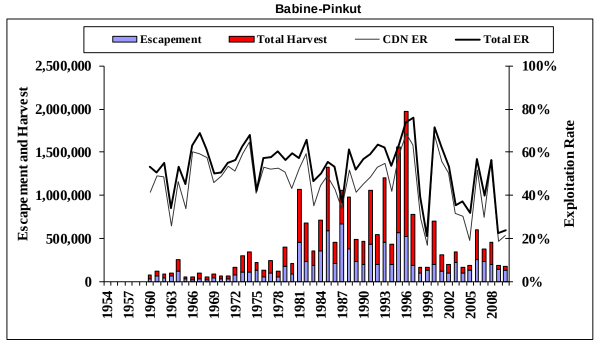
Babine-Late-Wild



Babine-Fulton

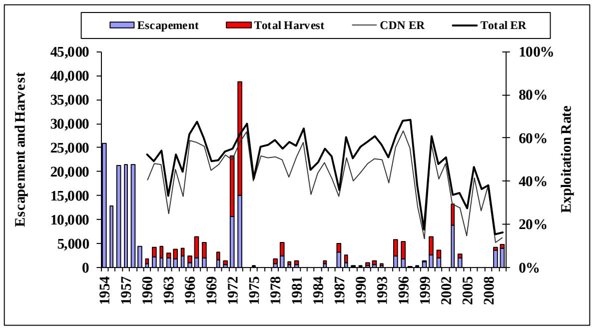


Babine-Pinkut

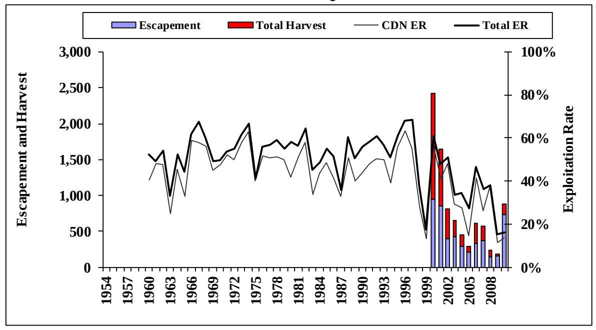


Appendix B - Area 4 Sockeye (continued)

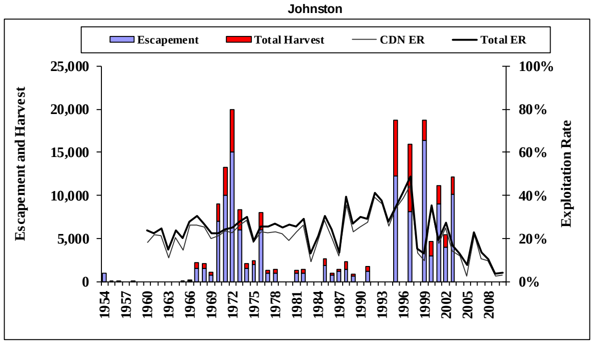
Bear



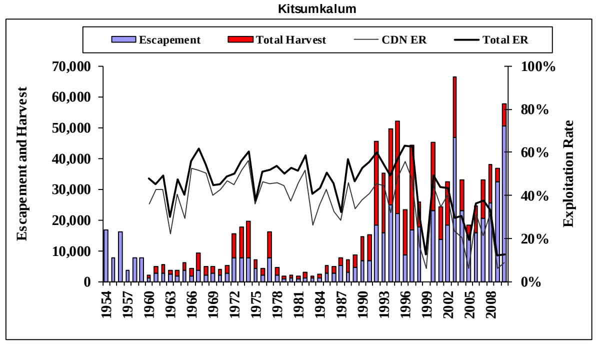
Damshilgwit



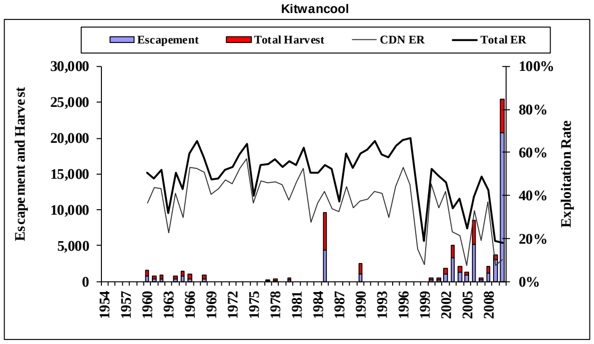
Johnston



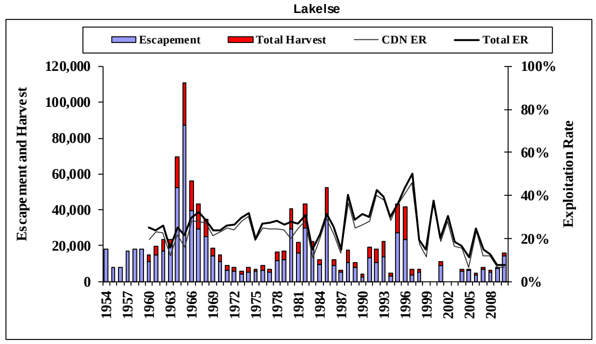
Kitsumkalum



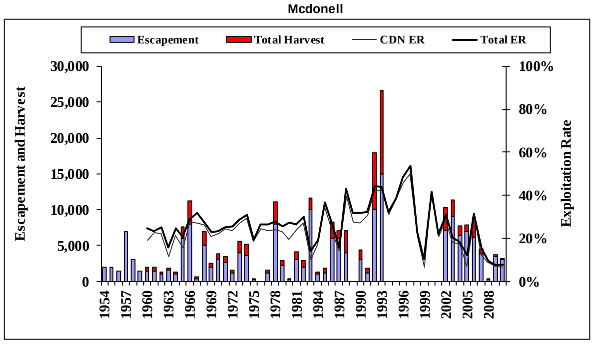
Kitwancool



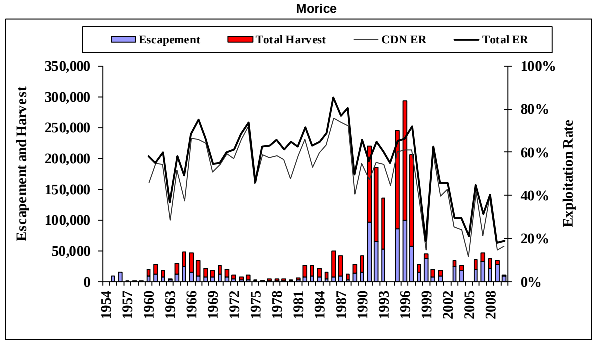
Lakelse



Mcdonell

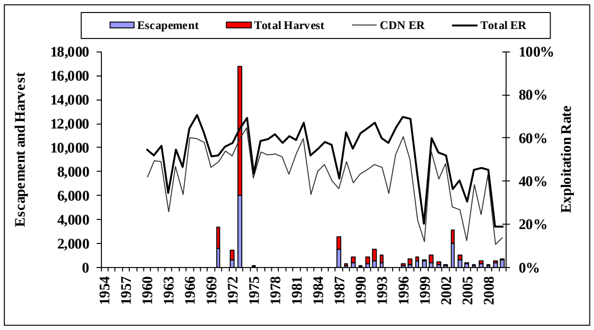


Morice

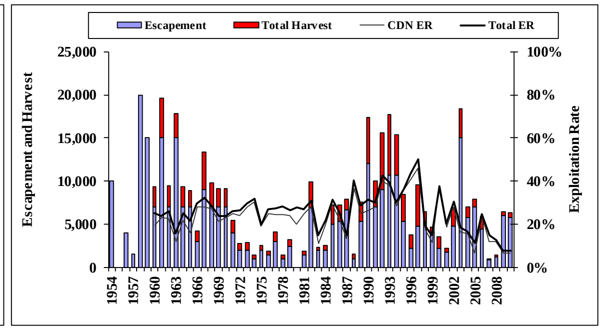


Appendix B - Area 4 Sockeye (continued)

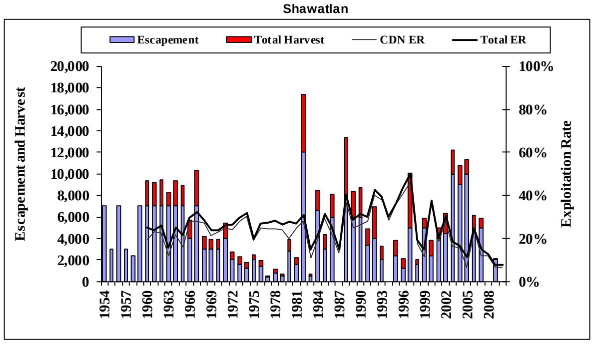
Motase



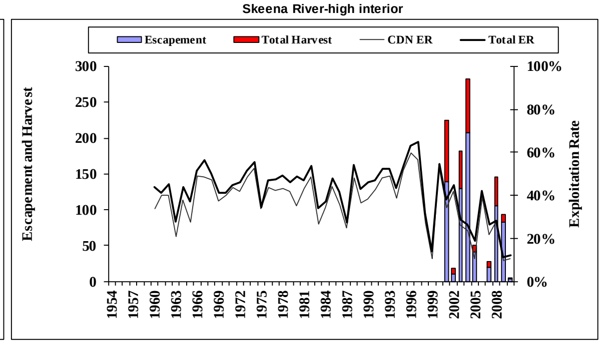
Prudhomme



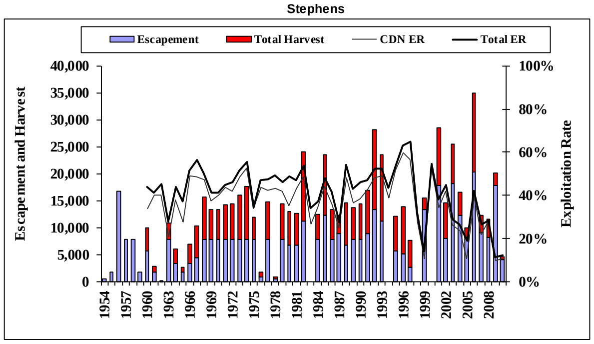
Shawatlan



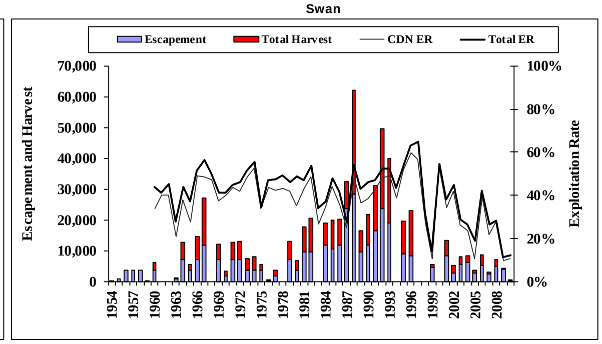
Skeena River-high interior



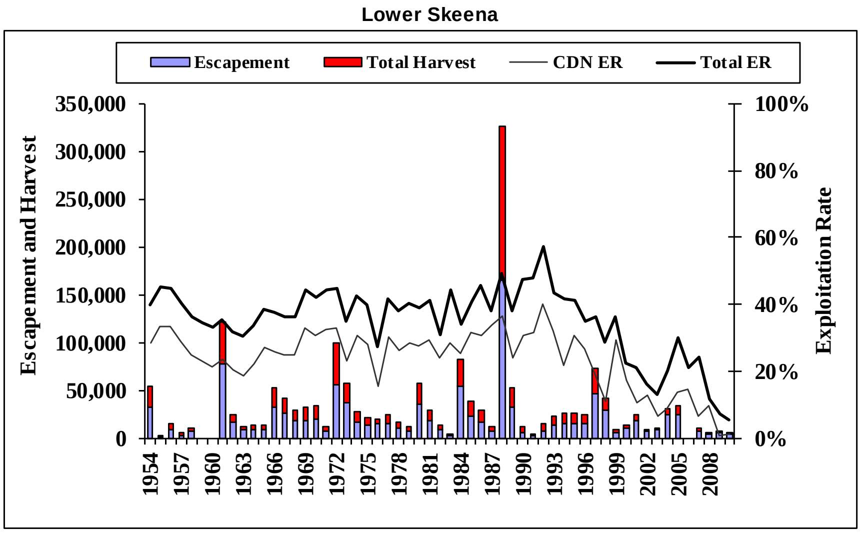
Stephens

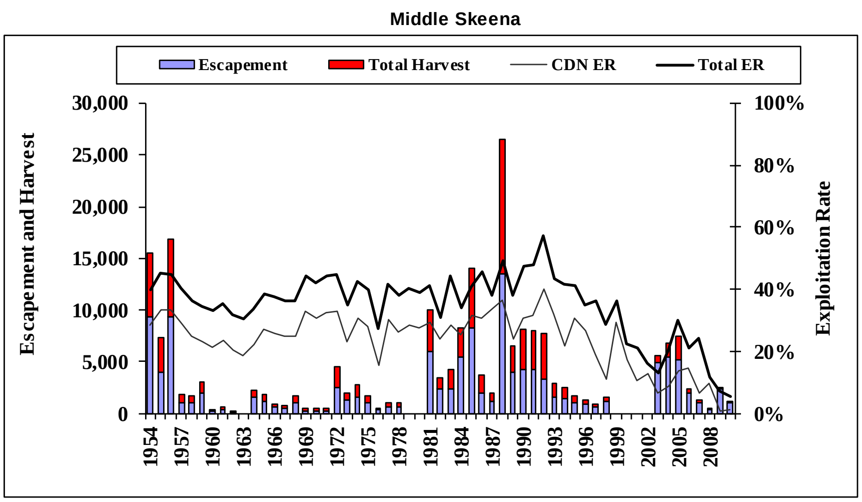


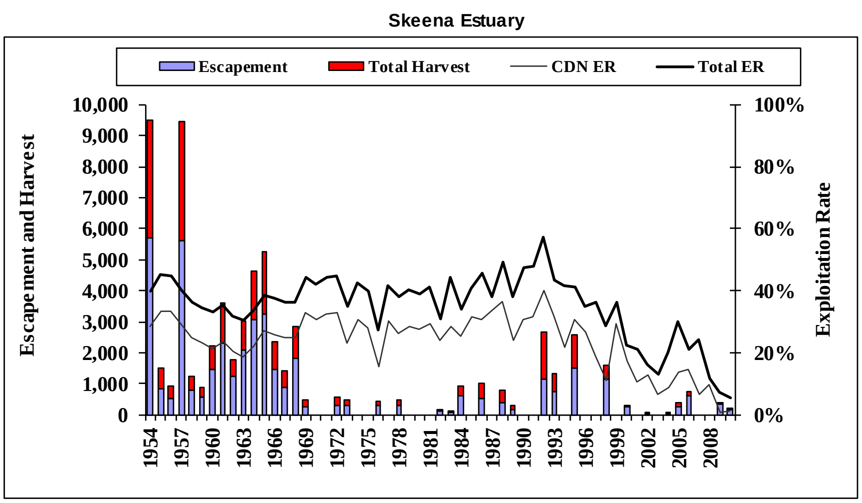
Swan



Appendix C - Area 4 Chum

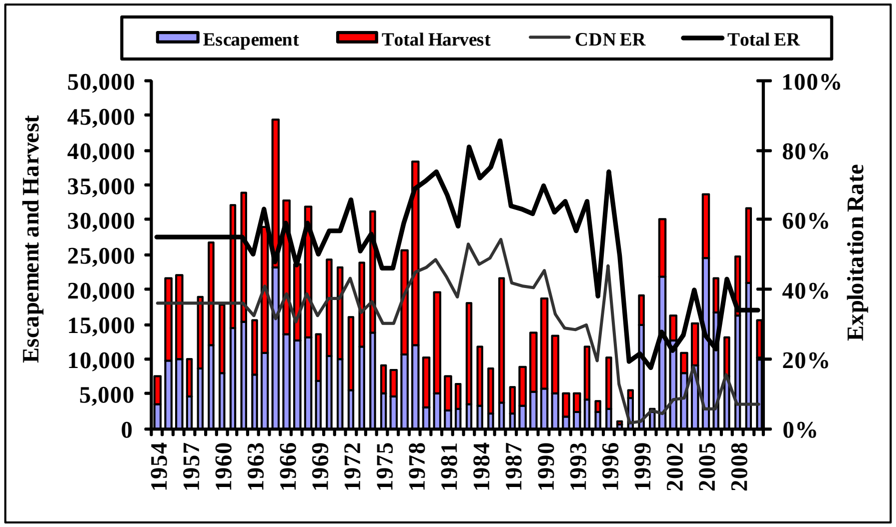




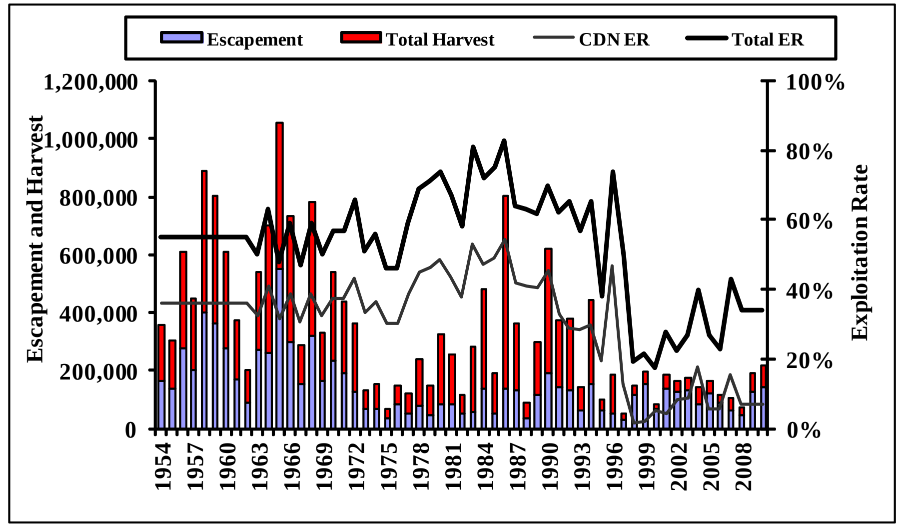


Appendix D - Area 4 Coho

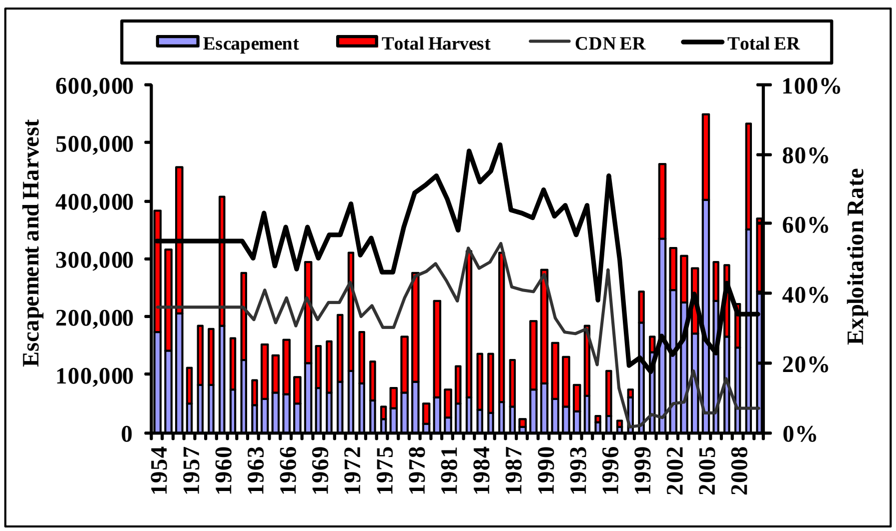
Babine



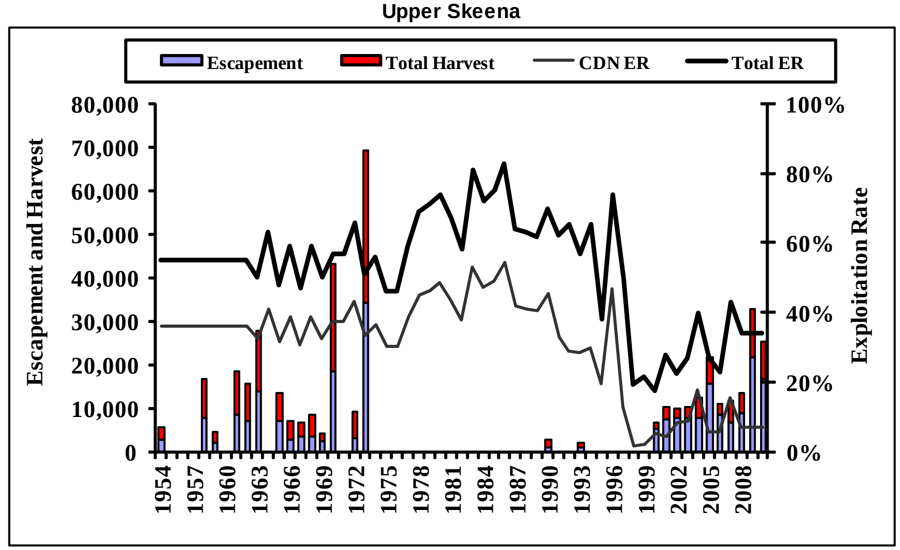
Lower Skeena



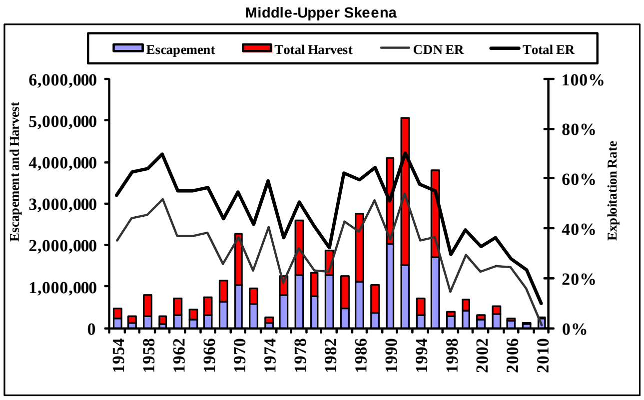
Middle Skeena

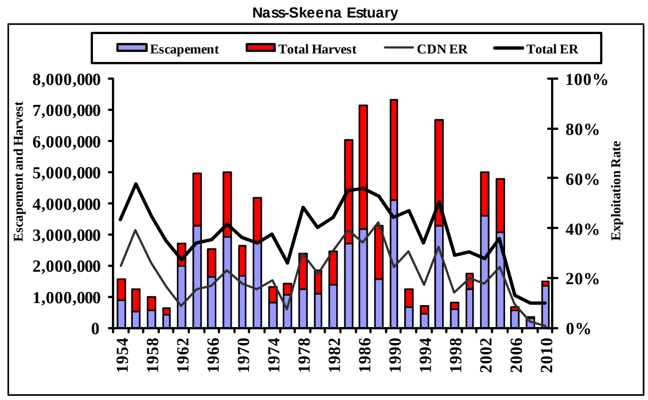


Upper Skeena

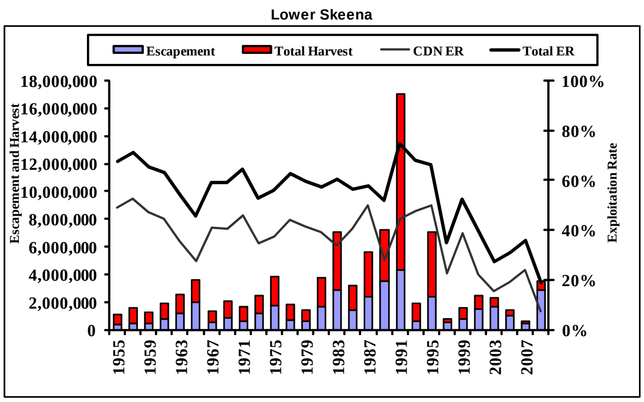


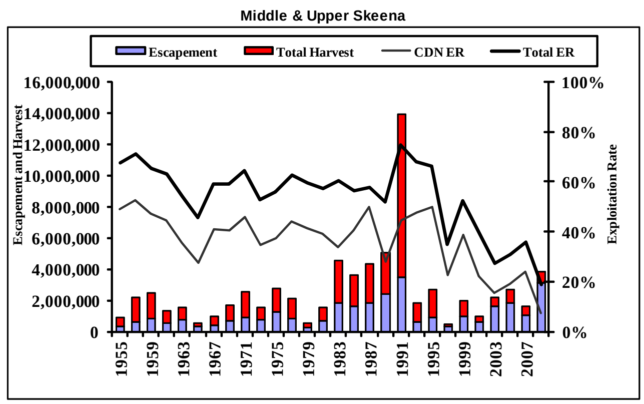
Appendix E - Area 4 Pink Even

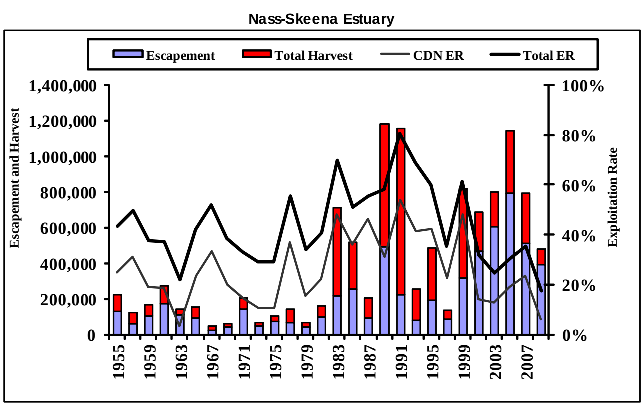




Appendix F - Area 4 Pink Odd







Appendix G. List of the Skeena Conservation Units and those included in our analysis for each species.

CU index	CU name	Notes on CU name, delineation & data sources.	Escapement Time Series
sockeye-lake type [SEL]			
L-20-1	Alastair		yes
L-20-4	Ecstall/Lower		
L-20-5	Johnston		yes
L-20-6	Kitsumkalum		yes
L-20-7	Lakelse		yes
L-20-8	Mcdonell	Includes Dennis (L-20-3 in HC2007) & Aldrich (L-20-2 in HC2007)	yes
L-21-2	Babine	Also known as "Babine early" or "Babine early wild"; includes sockeye spawing in non-enhanced tributaries to Babine Lake and in Onerka Lake. Data source is BabineEscapeKarlTable_1960-2010_30Jan2013.xls	yes
L-21-3	Bulkley	Includes Maxan (L-21-6 in HC2007)	
L-21-5	Kitwancool		yes
L-21-7	Morice	Includes Atna (L-21-1 in HC2007)	yes
L-21-8	Nilkitkwa	Also known as "Babine late" or "Babine late wild". Data source is BabineEscapeKarlTable_1960-2010_30Jan2013.xls	yes
L-21-9	Stephens		yes
L-21-10	Swan	Includes Club (L-19-4 in HC2007)	yes
L-21-11	Tahlo/Morrison	Also known as "Babine mid" or "Babine mid wild". Data source is BabineEscapeKarlTable_1960-2010_30Jan2013.xls	yes
L-22-1	Asitika		yes
L-22-2	Azuklotz		yes
L-22-3	Bear		yes
L-22-4	Damshilgwit		yes
L-22-5	Johanson		
L-22-6	Kluatantan		
L-22-7	Kluayaz		
L-22-8	Motase		yes
L-22-9	Sicintine		
L-22-10	Slamgeesh		
L-22-11	Spawning		
L-22-12	Sustut		
L-21-12	Footsore/Hodder	New CU that was not included in HC2007	
n/a	"Babine enhanced"	Not an official DFO CU, but included as an analysis unit in Korman. Data source is BabineEscapeKarlTable_1960-2010_30Jan2013.xls	yes
	TOTAL CUs: 28		**ESC TOTAL: 18**
Sockeye-river type [SER]			
R18	Skeena River		
R19	Skeena River-high interior		
	TOTAL CUs: 2		**ESC TOTAL: 0**

Appendix G. (continued).

CU index	CU name	Notes on CU name, delineation & data sources.	Escapement Time Series
chinook [CK]			
45	Skeena Estuary		
46	Ecstall		yes
48	Lower Skeena	Includes Gitnadoix (47 in HC2007)	yes
49	Kalum-Early		yes
50	Kalum-Late		yes
51	Lakelse		
53	Middle Skeena-large lakes		yes
54	Middle Skeena mainstem tributaries	Includes Middle Skeena (52 in HC2007)	yes
55	Upper Bulkley River		yes
56	Upper Skeena		
80	Zymoetz	New CU that was not included in HC2007	
	TOTAL CUs: 11		**ESC TOTAL: 7**
chum [CM]			
26	Skeena Estuary		yes
27	Lower Skeena		yes
28	Middle Skeena		yes
N/A	N/A	HC2007 also included a CU "Upper Skeena" (29)	
	TOTAL CUs: 3		**ESC TOTAL: 3**
coho [CO]			
31	Skeena Estuary		
32	Lower Skeena		yes
33	Middle Skeena		yes
34	Upper Skeena		yes
	TOTAL CUs: 4		**ESC TOTAL: 3**
odd-year pink [PKO]			
14	Nass-Skeena Estuary		yes
15	Lower Skeena River		yes
16	Middle & Upper Skeena River		yes
	TOTAL CUs: 3		**ESC TOTAL: 3**
even-year pink [PKE]			
7	Nass-Skeena Estuary		yes
8	Middle-Upper Skeena		yes
	TOTAL CUs: 2		**ESC TOTAL: 2**

Note: Unless otherwise noted, CU names and delineations match Holtby & Ciruna 2007 (HC2007).

The assignment of streams and indicator stream to each CU is provided along with other meta data and the nuSEDS escapement estimates in "NCCC_Streams1950-2010_2Nov2012.xls".

Stock recruit data for each species and CU are provided in "SR_Area04_1Feb2013+FD.xlsx".

The total escapement, catch and run size estimates by calender years are provided in "TRTC_Area04_14Feb2013+plots+FD.xlsm".