

**Kwinamass and Khutzeymateen Rivers
Chinook Salmon Escapement Surveys
2015**

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February, 2016

*A project funded by the Northern Boundary and Transboundary Rivers
Restoration and Enhancement Fund 2015. File NF-2015-I-34.*

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ABSTRACT

Chinook salmon (*Oncorhynchus tshawytscha*) escapements were estimated to the Kwinamass and Khutzeymateen Rivers in Northern British Columbia in 2015. A run size index from visual peak count surveys was calibrated against an abundance estimate generated using mark re-sight techniques. The escapement indices from the peak count surveys were 294 large Chinook salmon to the Kwinamass River and 260 large Chinook salmon to the Khutzeymateen River. The escapement estimates for large Chinook salmon after applying correction factors developed from previous mark re-sight programs was 651 to the Kwinamass River and 442 to the Khutzeymateen River.

INTRODUCTION

Funding for this project was provided by the Northern Boundary and Transboundary Rivers Restoration and Enhancement Fund (Northern Fund) to estimate Chinook salmon (*Oncorhynchus tshawytscha*) escapement to the Kwinamass and Khutzeymateen Rivers. The project provided access by helicopter which allowed for two float surveys of each river. The Kwinamass and Khutzeymateen Rivers are indicators of coastal chinook abundance in Area 3. The aerial and float survey methods have been calibrated through mark-recapture projects previously funded through the Northern fund. The relationship between visual indices and estimates of total spawners was determined and expansion factors were developed for Chinook salmon escapement indices in the Kwinamass and Khutzeymateen Rivers (Winther, 2006, 2011). This report presents the indices and the expanded escapement estimates for the Kwinamass and Khutzeymateen Rivers in 2015.

Interest in validating Chinook salmon escapement estimates in the Kwinamass and Khutzeymateen Rivers extends beyond the development and use of expansion factors for visual methods. These systems didn't respond to Pacific Salmon Treaty initiatives in 1985 as observed in many other systems in the North Coast of British Columbia. Visual escapement estimates in the 1960's and early 1970's varied between 750 and 5000 Chinook salmon in each river. These systems appear to epitomize the mixed stock problem as two small and apparently weak Chinook salmon populations located between the two large and relatively healthy populations of the Nass and Skeena Rivers.

The primary objective of this study was to generate estimates of Chinook salmon abundance in the Kwinamass and Khutzeymateen Rivers. Estimates of Chinook escapement in these clear running coastal streams are an important domestic management consideration. The seine Chinook release requirement was linked to the status of these stocks. The Kwinamass River watershed forms part of the Nisga'a Treaty area and the escapement estimates are used as part of the Nisga'a allocation calculations. Thus a priority is to provide annual, calibrated escapement estimates for these two coastal Chinook systems.

A significant time series of visual escapement indices exist for Chinook salmon stocks the Kwinamass and Khutzeymateen watersheds (Appendix 1). Estimates of Chinook salmon in the Khutzeymateen apply primarily to the Kateen River tributary. The estimates are similar to peak count extrapolations and essentially the same methods have been used for 20 years. These systems presented a fortunate scenario where the personnel conducting stream inspections remained static over a decade and the primary individual engaged in estimation of Chinook salmon in these systems was involved from 1985 to 2010.

Stream inspection logs for the Kwinamass and Khutzeymateen River systems have been prepared since 1985. The logs provide information on live and dead Chinook salmon observed and stream conditions during each inspection. These raw data allow for comparison of the existing indices (commonly referred to as Fishery Officer estimates) to other methods of generating escapement estimates using the same data (e.g. area under the curve or peak count estimates).

Mark re-sight experiments were conducted on the Kwinamass River for 5 years, 2002 to 2006 inclusive and on the Khutzeymateen River for 6 years, 2005 to 2008, 2010 and 2011. Fishery Officer estimates were continued over this time, independent of the mark re-sight estimates. Recoveries of Chinook salmon carcasses from the Kwinamass and Khutzeymateen Rivers were extremely limited due to the predators that inhabit the area (bears and wolves). To make up for the inability to sample a representative portion of the population from carcasses the recapture portion of the study consisted of observations of marked and unmarked live Chinook

salmon during swim and boat surveys. The swim surveys were most effective (i.e. observed the most Chinook salmon) when they were timed just before spawning when the fish were holding in pools. The boat surveys were more effective when the Chinook salmon were spawning and could be observed in the shallow riffles. The mark-resight estimates formed the basis or “true” estimates used to calibrate the Fishery Officer values.

METHODS

The total numbers of large Chinook salmon spawning in the Kwinamass and Khutzeymateen Rivers were estimated from a series of visual observations. The watersheds are remote and were accessed by helicopter (Figure 1). An inflatable raft was used to float the observers down the river. Channels that were not accessible to the raft were walked to observe spawning and holding fish. Live fish were recorded as holding or spawning. Holding fish were typically associated with deeper water and pools and spawning fish were associated with shallower riffles. Dead fish were also recorded.

The abundance index is calculated as the total number of fish, live or dead, observed on the first survey plus the number of new fish observed in subsequent surveys. This sum is then doubled to form the index. The “new” designation is subjective and based on the condition of the fish as well as the time between surveys. The 2015 Kwinamass River index was twice the peak count observed on 19 August. The 2015 Khutzeymateen River index was slightly more than twice (2.1) the peak count observed on 15 August.

The expansion factors used for converting visual indices of large Chinook salmon to total escapement were 2.2 for the Kwinamass and 1.7 for the Khutzeymateen.

RESULTS

The 2015 visual index of Chinook salmon escapement for the Kwinamass River was based on float counts made on 19 and 26 August (Table 1). The visual index generated from these surveys was 296 large Chinook salmon.

The 2015 visual index of Chinook salmon escapement for the Khutzeymateen River was based on float counts made on 15 and 25 August (Table 1). The visual index generated from these surveys was 260 large Chinook salmon.

DISCUSSION

The Kwinamass and Khutzeymateen Chinook salmon populations have been assessed with a visual index method since 1985 to produce a range of the indices between 100 and 925 fish in the Kwinamass and between 90 and 750 fish for the Khutzeymateen. The visual indices measure large Chinook salmon which are consistent with the estimate of large Chinook salmon measured by mark re-sight programs that were designed to calibrate the indices.

The factor used for expanding the Kwinamass visual index to mark-recapture estimates of total escapement was 2.2. This expansion factor was the average of 5 years of study and had a standard deviation of 0.51 and a CV of 23%. The contrast across the estimates was 2.0 with mark-recapture estimates that ranged between 771 and 1,512 Chinook salmon (Winther and Parken, 2006 & 2007).

The factor for expanding the Khutzeymateen visual index to mark-recapture estimates of total escapement was 1.7. This expansion factor was the average across 6 years of study with a standard deviation of 0.43 and a CV of 25%. The contrast across the joint hypergeometric estimates was 4.4 with mark-recapture estimates that ranged between 200 and 880 Chinook salmon (Winther, 2011).

The Pacific Salmon Treaty outlined tasks for the Chinook Technical Committee (CTC), which included establishing biologically-based escapement goals. Most stocks do not have sufficient spawner and production data to estimate optimal spawning escapements. Most data limited stocks only have indices of abundance and additional information is required to convert the indices to total numbers of spawning fish. This project estimated total escapement by mark re-sight while performing the visual index method to establish the relationship between the index and the total escapement estimate. Parken et. al. (2006) developed a habitat model that predicts the spawners required for maximum sustainable yield and replacement of Chinook salmon based on the size of the watershed used by the stock. An objective the studies of Kwinamass River and Khutzeymateen / Kateen River Chinook salmon was to relate population parameters developed using the habitat based approach with the abundances represented by the visual indices. The habitat based estimate of the Chinook salmon escapement required to produce maximum sustained yield (S_{msy}) in the Kwinamass River was 1,100 fish and the habitat based estimate of capacity was 3,010 fish. The habitat based estimate of the Chinook salmon escapement required to produce S_{msy} in the Khutzeymateen River was 999 fish and the habitat based estimate of capacity was 2,714 fish. While biologically based escapement targets have not been fully developed for these stocks the historic time series may now be considered in terms of total fish and compared with the habitat based population parameters (S_{msy} and capacity).

The CTC has considered data standards for factors used to expand escapement indices with respect to the development of biologically based escapement goals for Chinook salmon. The draft recommendations include the criteria that expansion factors be based on a minimum of 3 years data and that the coefficient of variation (CV) for the point estimates should not exceed 20% across years. At 23% and 25% respectively the CV's around the expansion factors for Kwinamass and Khutzeymateen Chinook salmon remain outside of the draft data standard. The CTC guidelines include the criteria that the contrast in escapements (largest/smallest) used to generate expansion factors should exceed 4. The contrast in the escapements sampled is close to the data standard for the Khutzeymateen (4.4) but below the data standard for the Kwinamass (2.0). The existing factors have been derived from testing the lowest end of the escapement range. Fully understanding the relationship between the visual indices and estimates of total abundance would benefit from sampling larger populations.

ACKNOWLEDGEMENTS

The stream surveys were conducted by C. Martens, Fisheries and Oceans Canada and J. Trainer, chartered patrolman.

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TABLES

Table 1. Visual counts of spawning Chinook salmon in the Kwinamass and Khutzeymateen Rivers in 2015.

River	Date	Holding large Chinook	Spawning large Chinook	Dead large Chinook	Total large Chinook observed
Kwinamass	Aug. 19	0	145	3	148
Kwinamass	Aug. 26	0	87	7	94
Khutzeymateen	Aug. 15	51	70	0	121
Khutzeymateen	Aug. 25	0	57	4	61

FIGURES

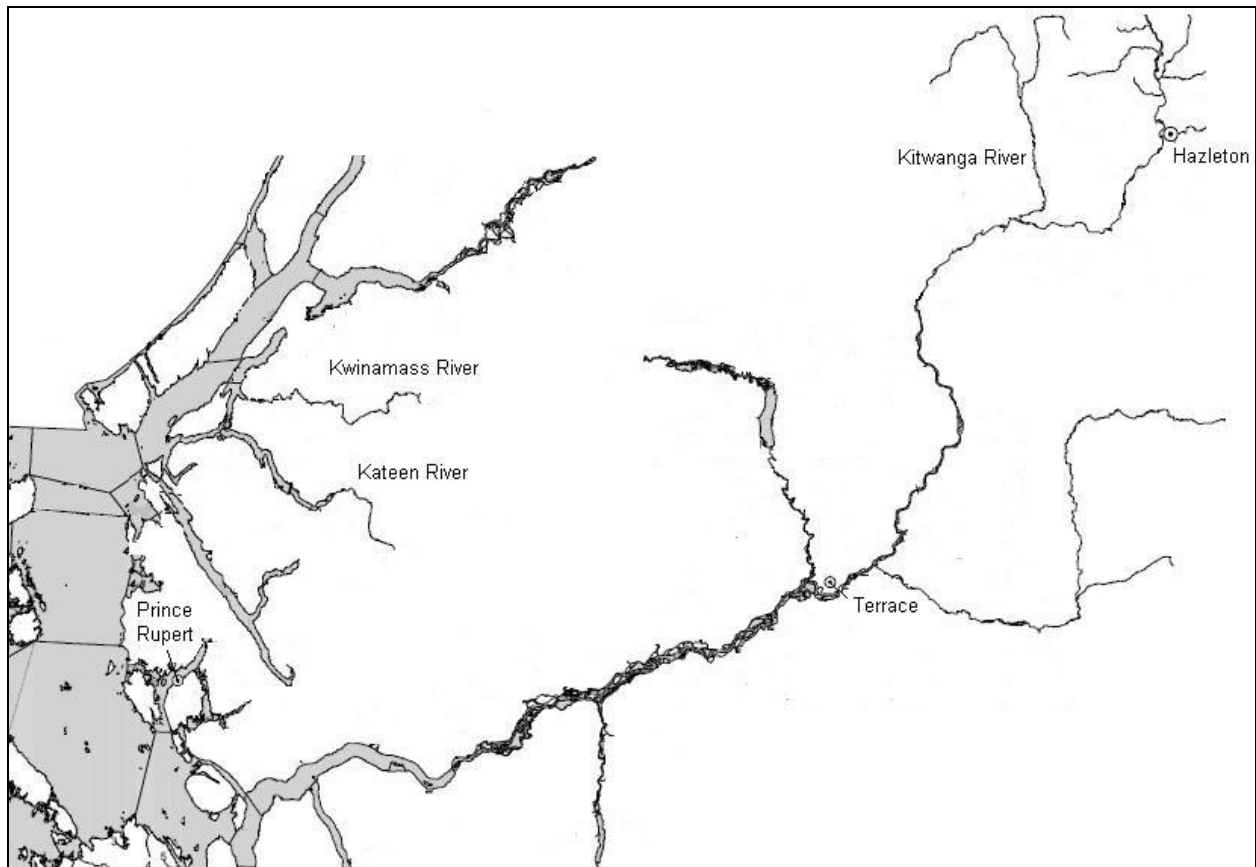


Figure 1. Location of the Kwinamass and Khutzeymateen / Kateen Rivers in northern British Columbia.

APPENDICES

Appendix 1. Chinook salmon escapements to Kwinamass and Khutzeymateen Rivers from Fishery Officer records.

Year	Kwinamass	Khutzeymateen
1962	1500	
1963	3500	
1964	1500	3500
1965	3000	800
1966	5000	1000
1967	3500	800
1968	5000	5000
1969	1000	750
1970	1200	750
1971	2500	750
1972	1000	2000
1973	300	
1974	1200	
1975	1000	
1976	500	500
1977	600	1000
1978	700	700
1979	300	800
1980	300	300
1981	300	300
1982	500	500
1983	150	200
1984	300	300
1985	200	300
1986	600	500
1987	300	750
1988	300	300
1989	200	200
1990	350	325
1991	300	300
1992	295	275
1993	200	200
1994	100	100
1995	100	100
1996	300	A/P
1997	300	150
1998	400	100
1999	200	100
2000	300	300
2001	700	600
2002	600	300
2003	450	150
2004	400	A/P
2005	400	350
2006	500	450
2007	925	550
2008	120	200
2009	260	A/P
2010	350	90
2011	A/P	135
2012	354	230
2013	A/P	157
2014	600	235
2015	296	260

AP = adults present but no estimate available, blank cells were not surveyed

Appendix 2. Comparisons of visual indices of Chinook salmon escapement with mark re-sight estimates for the Kwinamass and Khutzeymateen Rivers.

Year	Visual Index	MR Estimate	MR 95% CL	MR / visual Factor
2005	350	600	300-1750	1.71
2006	450	880	600-1560	1.96
2007	550	730	490-1180	1.33
2008	250	270	150-730	1.08
2010	90	200	140-370	2.22
2011	135	260	180-440	1.93
Contrast	6.1	4.4		
	Average			1.70
	Standard Deviation			0.43
	Coefficient of variation			25%

Year	Visual Index	MR Estimate	MR 95% CL	MR / visual Factor
2002	600	1176	930-1450	1.96
2003	450	771	530-930	1.71
2004	400	813	530-1180	2.03
2005	400	957	750-1200	2.39
2006	500	1512	1240-1840	3.02
Contrast	1.5	2.0		
	Average			2.2
	Standard Deviation			0.5
	Coefficient of variation			23%

MR = mark-resight, CL = confidence limit