Central Coast Chinook Salmon Escapement Surveys 2015; Final Report for Pacific Salmon Commission (CSA 57123)

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Introduction:

Chinook salmon populations in Area 8 consist of seven non-enhanced systems, and the Bella Coola and Atnarko River system which is enhanced. Among non-enhanced systems the Dean River has the largest spawning population and the most consistent escapement surveys. Chinook salmon returning to the Dean River exhibit summer timing and are predominantly stream type (94%).

The Dean River is a Chinook Technical Committee (CTC) escapement indicator for the central coast. Prior to the 2015 PSC funded aerial assessment project, this system was last surveyed in 2011. Between 2001 and 2011, the Chinook salmon escapement index for the Dean River was derived using area-under-the-curve (AUC) methodology based on three aerial counts. In years where viewing conditions were poor, a maximum likelihood procedure was used.

STUDY AREA

The Dean River is located along the central west coast of British Columbia. It originates at Nimpo Lake approximately 150 km east of the community of Bella Coola and flows in a north-westerly direction for approximately 253 km before entering the Dean Channel (Figure 1).

Several tributaries provide salmon spawning habitat to the Dean River between Nimpo Lake and Dean Channel including the Takia River, Tahyesco River and Sakumtha Creek. The upstream limit to the migration of spawning salmon is Salmon House Falls near the confluence of the Takia River and the Dean River. Spawning Chinook salmon have been observed in the Takia River near the lower Tanya Lake, in the Tahyesco River as far as Compass Creek, and Sakumtha Creek near Skuce Creek.

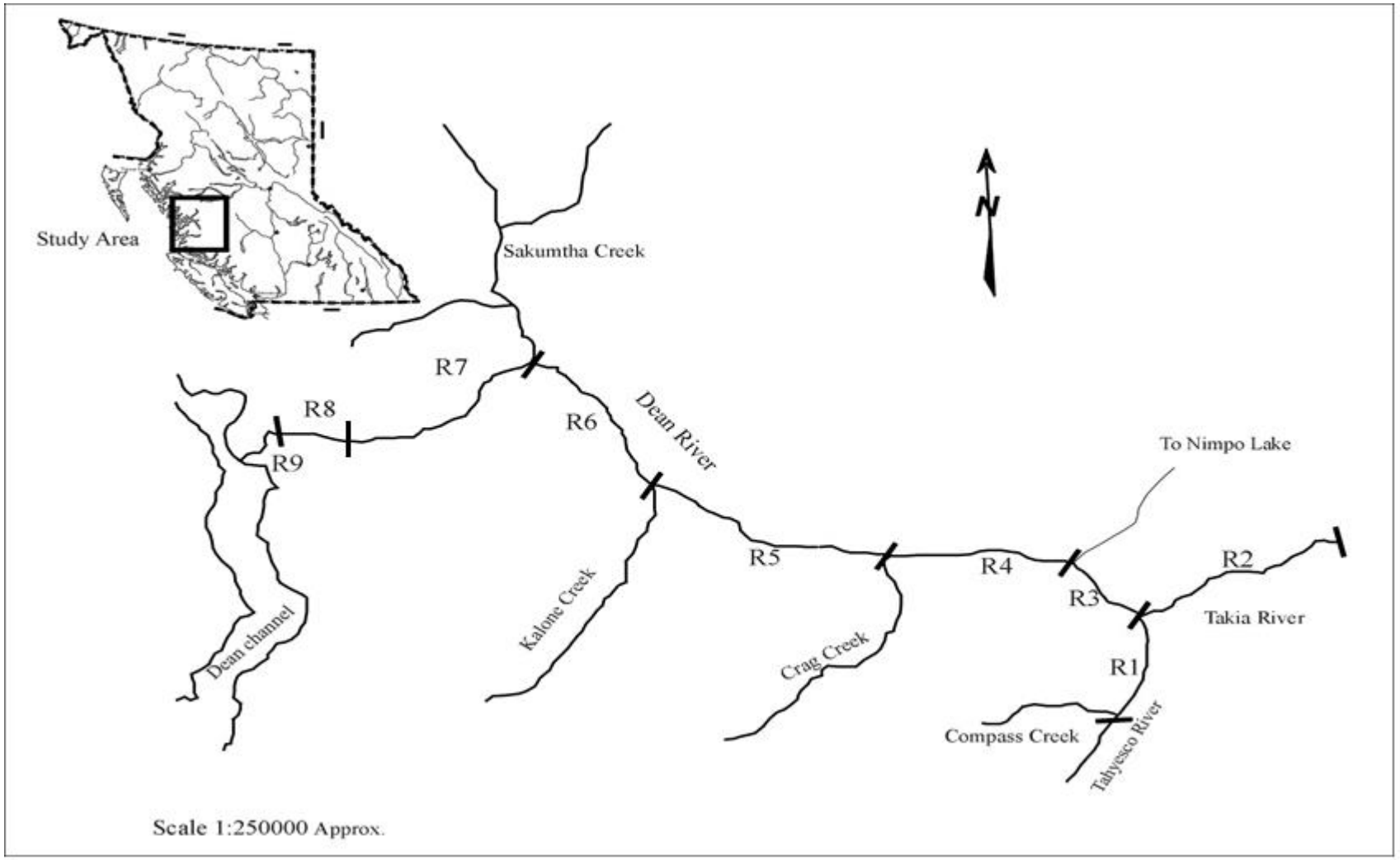
Salmonid species inhabiting the Dean River include Chinook salmon, coho salmon (*O. kisutch)*, pink salmon (*O. gorbuscha*), chum salmon (*O. keta*)*,* sockeye salmon (*O. nerka*), steelhead and rainbow trout (*O. mykiss*), and dolly varden (*Salvelinus malma*). Non-salmonids include longnose suckers (*Catastomus catastomus*), sculpins (*Cottus* spp.), and northern pike-minnow (*Ptychocheilus oregonensis*) (Fish Data Warehouse).

For the purposes of this study, the Dean River and its major tributaries were divided into nine sections described in Table 1.

Table 1. River sections and associated stratum designations.

River Segment	Stratum	Length (km)
Tahyesco / Compass Junction to Takia River	1	6.0
Tanya Lakes to Tahyesco / Takia Junction	2	14.5
Tahyesco / Takia Junction to Salmon House Falls	3	7.0
Salmon House Falls to Crag Creek	4	9.0
Crag Creek to Kalone Creek	5	14.5
Kalone Creek to Sakumtha Creek	6	12.5
Sakumtha River to Canyon	7	13.5
Camp to Canyon	8	3.5
Canyon to Mouth	9	3.0

Figure 1. Study area map and strata locations for the Dean River 2015.



Methodology

AERIAL ENUMERATION

Aerial counts were performed during low level (20 - 40 m elevation) flights in either a Bell 206 Long Ranger or an Aero-Star B2 helicopter at low speeds between 10 and 40 km/h. All flights except the Takia River portion were assessed proceeding in a downstream direction. Three flights were conducted between August 25 and September 15, 2015 with flight days occurring prior to, during, and after the expected peak of spawning activity. Observed efficiency for each flight was estimated by section and recorded. Two observers were seated on the same (port) side of the aircraft and the helicopter was oriented to provide best views from that side. They counted all Chinook salmon observed and recorded them as either live or dead (carcasses) by stratum; count information was shared during the counts and at the end of each stratum count the observers pooled their individual tallies to determine an estimate for the stratum.

Aerial Escapement

Estimates of escapement were derived by dividing stratum counts of fish by respective observed efficiency and summing the totals to obtain an estimate of the total daily count. The total daily counts were incorporated into a trapezoidal Area-Under the Curve (AUC) escapement estimator. The AUC was calculated according to Irvine et al. (1992):

$$AUC = 0.5 \cdot \sum_{i=2}^{n} (t_i - t_{i-1}) \cdot (p_i + p_{i-1})$$

where t_i is the number of days since the first fish commenced spawning, n is number of overflight surveys + 2, and p_i is the estimated number of spawning salmon on the i^{th} day. Surveys were temporarily bounded by the day the first fish commenced spawning ($i=1$, $p_i=0$) and the first day it was assumed there were no longer any live spawners remaining (t_n, where $p_n=0$).

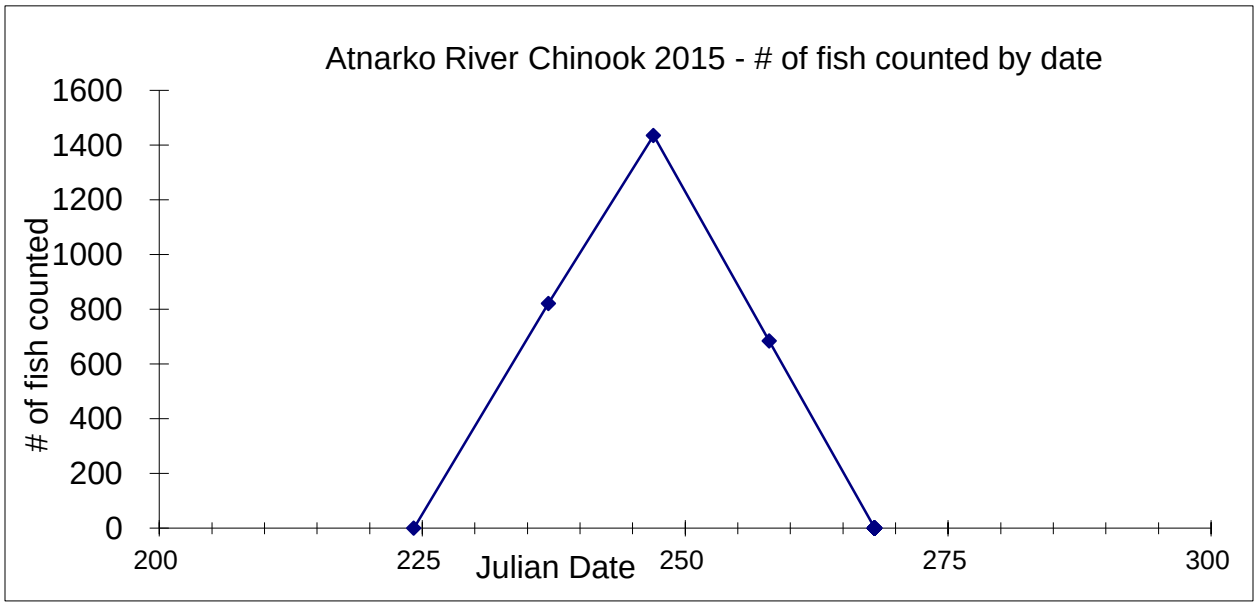
The AUC (in fish-days) was divided by the estimated survey life (in days) to determine the index of abundance based on aerial enumeration.

RESULTS:

Aerial Enumeration

Three aerial enumeration flights were conducted (Appendix 1). Flights took place on August 25, September 4 and September 15 with the peak count occurring on September 4, 2015. Area-under-the-curve (AUC) calculated approximately 31,615 fish-days when the trapezoidal method was applied to describe the temporal distribution of spawning activity (Irvine et al. 1992). Residence time of 12.8 days was attributed to the trapezoidal AUC method to yield an escapement estimate of 2,470 Chinook. While it has been suggested the residency may be shorter, additional assessment is necessary to substantiate use of shorter residency time (Parken et al. 2007)

Figure 2. Trapezoid curve fitted to Chinook spawner count data for the Dean River, 2015.



DISCUSSION

Among Chinook salmon spawning systems, the accuracy of aerial estimates are influenced by the physical conditions at the time of counting. Light penetration, water clarity, fish behavior and weather all influence fish visibility (Bevan 1961). Reflection of the sun also has a marked effect on the ability of observers to count fish at certain times. Other factors influencing aerial estimates include the experience of the pilot and observers, flight scheduling, frequency of

counts (Bevan 1961; Neilson and Geen 1981), abundance and density of conspecifics and other species, river size, overhead vegetation, survey life and other factors.

Flights were scheduled to maximize as much as possible the viewing conditions. In this study, flights were conducted between 1100h and 1300h to ensure the sun was high in the sky to minimize glare and maximize light penetration. While all observers had polarized glasses, glare was still a factor at certain locations and counting was difficult when flying from brightly illuminated areas into shade. Water turbidity was a minor factor influencing counts due to low and relatively clear water conditions. Counting conditions were considered good for all flights.

Salmon are counted most easily when dispersed into shallow spawning grounds at the peak of spawning (Cousens et al. 1982), flights were scheduled to coincide with the peak of spawning. During the first flight it was noted that spawning had occurred on the Takia River and some carcasses were noted; conversely in the Dean River main stem the first flight noted large numbers of fish holding in pools while on the last two flights there were significant numbers of carcasses and vacated redds. This indicates the peak of spawning had occurred earlier on the Takia River, and had likely peaked in the Takia River on or about August 25, 2015 whereas it appears to have peaked on or about September 4, 2015 for the Dean River main stem.

Survey life is an important parameter to produce accurate AUC escapement estimates (Perrin and Irvine 1990). Survey life times have been determined as species, stream, and year specific. However, for data-limited systems such as the Dean River, estimates of survey life from other nearby systems with similar characteristics are used. In this case the assumed survey life of 12.8 days from the Chuckwalla and Kilbella Rivers has been used.

Summary and Recommendations:

1. Enumeration flights were undertaken on August 25, September 4 and 15, 2015. The count nearest the peak was September 4, 2015 with an estimate of 2,220 live fish.

2. Peak spawning in the Takia River appears to be earlier than in the rest of the Dean system, timing of the first flight should be adjusted earlier to capture that timing difference specifically the time before the Takia River peak.

3. A total AUC estimate of 31,615 fish days corresponds to an estimated escapement of 2,470 Chinook for 2015.

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Appendix 1. Number live and dead chinook observed, Dean River aerial enumeration flights, 2015.

Reach Description	Live /	Dead	Live /	Dead	Live /	Dead
Tahyesco / Compass Junction to Takia River	15	0	25	2	31	4
Tanya Lakes to Tahyesco / Takia Junction	96	63	20	40	a	a
Tahyesco / Takia Junction to Salmon House Falls	47	0	74	0	70	4
Salmon House Falls to Crag Creek	135	0	330	0	51	0
Crag Creek to Kalone Creek	1	0	64	0	23	0
Kalone Creek to Sakumtha Creek	14	0	139	0	77	9
Sakumtha River to camp	0	0	48	0	47	3
Hodson's Camp to Canyon	1	0	79	0	33	3
Canyon to Mouth	0	0	0	0	0	0
Totals	307	63	779	42	332	23
Totals Corrected for Observer Efficiency	663	158	1435	108	684	51

a. Reach not assessed; spawning finished