

Department of Fish and Wildlife

Low Elevation Fisheries

North Central Region

Butte Creek Spring-Run Chinook Salmon Escapement Survey September 2017 – October 2017

By

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INTRODUCTION

The 90-mile anadromous portion of Butte Creek extends from the base of the Centerville Head Dam downstream to the confluence of the Sacramento River near Sacramento Slough. Butte Creek supports one of three remaining tributaries that harbor a self-sustaining population of Central Valley spring-run Chinook salmon (*Oncorhynchus tshawytscha*); the other two tributaries are nearby Deer and Mill creeks. The 2017 Butte Creek escapement survey was conducted on the approximately 14.5 river miles from Quartz Bowl Pool downstream to Parrott-Phelan Diversion Dam (Appendix A). The survey was divided into six separate reaches, which were surveyed once a week from 26 September 2017 through 2 November 2017 (Table 1).

Table 1. Butte Creek Chinook Salmon Escapement Survey Reaches.

Reach	Location	Miles
A (sub reaches 1-5)	Quartz Bowl Pool to Whiskey Flat	1.89
B (sub reaches 1-8)	Whiskey Flat to Helltown Bridge	2.17
C (sub reaches 1-12)	Helltown Bridge to Quail Run Bridge	3.46
D (sub reaches 1-8)	Quail Run Bridge to Cable Bridge	1.93
E (sub reaches 1-7)	Cable Bridge to Centerville Covered Bridge	1.71
Covered Bridge to Parrott-Phelan Diversion Dam	Covered Bridge to Parrott-Phelan Diversion Dam	3.41
-	TOTAL	14.57

The purpose of the survey is to estimate the number of returning spring-run Chinook adults that successfully return to Butte Creek and spawn. The spring-run escapement surveys on Butte Creek have been conducted since 2001 and have been used to compare escapement estimates against the traditional swimming snorkel methodology. Snorkel survey methodology likely underestimates the number of adults in Butte Creek when there are large populations (Garman, 2019).

This is the first year since 2003 that an extensive pre-spawning mortality survey has not been conducted because of funding constraints. Pre-spawning mortality surveys allow close monitoring of the population over critical summer holding period. They can produce mortality estimates and can be added to different survey methods (snorkel, Vaki) that can explain the difference in escapement estimates from summer holding to fall spawning. Additionally, without pre-spawning mortality monitoring in place, it is difficult to assess total escapement into Butte Creek versus what proportion of the population successfully spawn.

MATERIALS AND METHODS

The survey extended from the Quartz Bowl Pool to the Parrott-Phelan Diversion Dam. The approximately 14.5-mile stream section was divided into six reaches. The first five reaches were then subdivided into approximately 0.25-mile segments. The reach described as “Centerville Covered Bridge to Parrott-Phelan Diversion Dam” was subdivided into three segments. Each

reach was surveyed once per week. Department personnel spread out and walked downstream, covering both sides of the creek and any side channels. All Chinook salmon carcasses encountered while conducting the escapement survey were collected and evaluated for their status of decomposition and the presence of a coded-wire tag (CWT). Levels of decomposition were determined by the coloration of the fish's eyes and gills. Carcasses containing either one clear eye or pink coloration of the gills were determined to be 'fresh' fish. Carcasses failing to contain one of the above-mentioned requirements were determined to be 'non-fresh.' Along with the determination of decomposition, both fresh and non-fresh carcasses were inspected for the presence of a CWT.

All fresh fish were identified to sex and measured to the nearest millimeter (mm) fork length. Carcasses with a fork length ≥ 600 mm were classified as adult fish, while fork lengths ≤ 600 mm were classified as grilse, or young adult fish. Fresh carcasses possessing an adipose fin were processed and tagged with a unique numbered metal disc attached to the maxilla. Following the attachment of a metal disc tag, carcasses were returned to flowing water to simulate natural downstream dispersal. Decomposing non-fresh carcasses were chopped in half to prevent recounting. Non-fresh previously marked carcasses were either chopped in half or left in place and were recorded as a recovery. Fresh adult carcass data was used in the Cormack Jolly-Seber Superpopulation model to estimate population size.

Tissue samples were taken from the first 10 fresh carcasses encountered in each reach. Clean scissors were used to cut a small piece (10-mm^2) of tissue from the caudal fin. If all fins were eroded or decayed, a small piece of skin was taken. Each sample was placed in a pre-labeled vial containing tris-buffer. Between each sample, scissors were rinsed in fresh water to prevent cross contamination.

Scale samples were collected from fresh carcasses with firm skin and from a one in^2 section on the side of the carcass below the posterior insertion point of the dorsal fin and slightly above the lateral line.

Flow data were obtained for the survey period from the Department of Water Resources California Data Exchange Center at Butte Creek near Chico gauge (Station Id BCK). Water temperatures were obtained from Onset Hobo Data Loggers launched at Quartz Bowl Pool in Upper Butte Creek.

Cormack-Jolly-Seber (CJS) mark-recapture model for open populations (Bergman, et al. 2012) using R statistical software, version 3.3.2 (www.r-project.org).

RESULTS

Survey Periods

Sampling occurred every Tuesday and Thursday during each sampling date range. There were no survey days that were cancelled due to inclement weather or high water flows. During the 2017 snorkel survey, each fish encountered was processed because fewer fish were observed. The survey was conducted over 6 survey periods from September 26, 2017 to November 2, 2017 (Table 2).

Table 2. Butte Creek spring-run survey sampling periods for 2017.

Survey Period	Date Range
1	Sept 26 – 28
2	Oct 3 – 5
3	Oct 10 – 12
4	Oct 17 – 19
5	Oct 24 – 26
6	Oct 31 – Nov 2

Final Carcass Count

A total of 182 carcasses was collected and processed during the 6 week survey period. The maximum number of carcasses observed in a single survey period was 47 during survey period 4 (Oct. 17-19) (Table 3, Figure 1).

Table 3. Total salmon carcasses processed and observed from September 26 to November 2, 2017.

Survey Period	Date Range	Total Carcasses
1	Sept 26 – 28	21
2	Oct 03 – 05	27
3	Oct 10 – 12	37
4	Oct 17 – 19	47
5	Oct 24 - 26	30
6	Oct 31 – Nov 02	20
Total		182

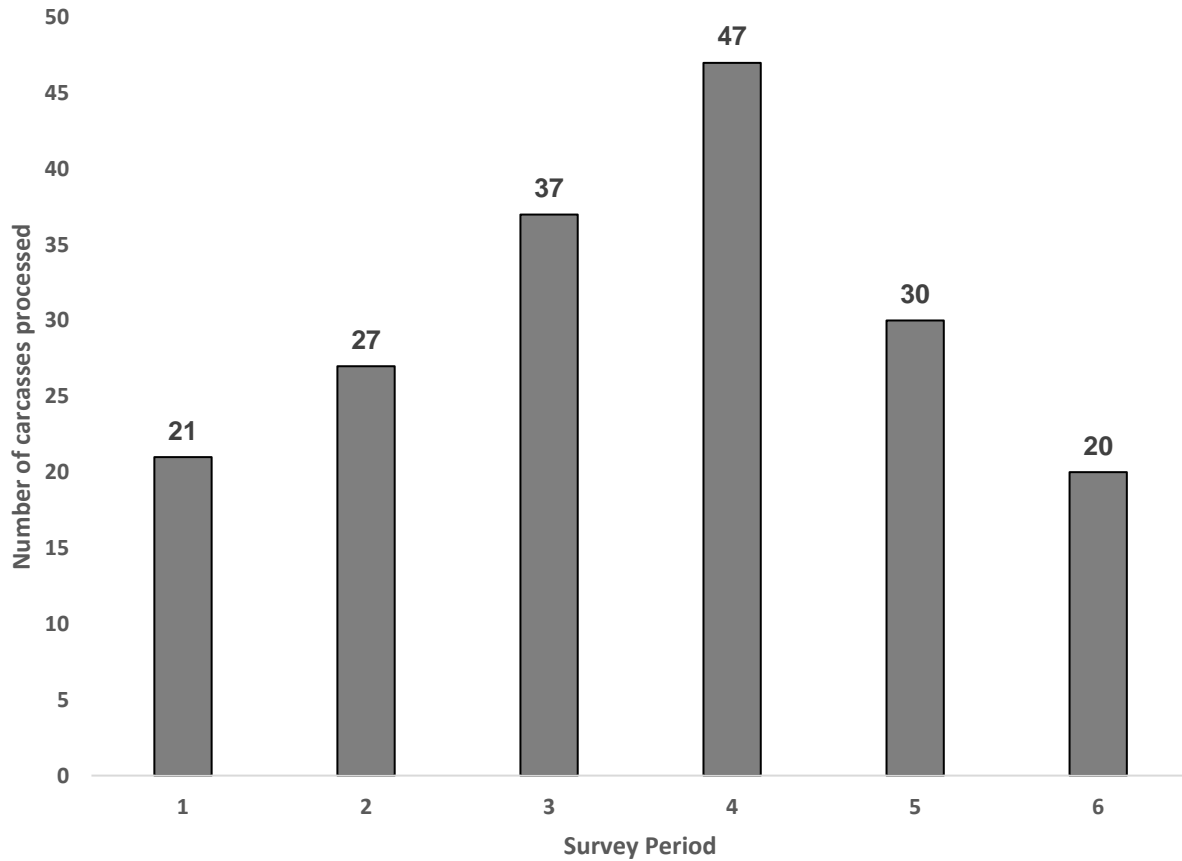


Figure 1. Number and temporal distribution of carcasses processed during the 2017 Butte Creek salmon escapement survey.

Fresh carcasses were processed every survey period except for period 6. All carcasses encountered during survey period 6 were chopped and no tags were applied to any fish. The greatest number of fresh carcasses occurred during survey period 3 when 18 were processed. The majority of all carcasses that were handled were non-fresh (66%, $n = 121$), 34% ($n = 61$) were recorded as fresh (Table 4 and Figure 2).

Table 4. Summary of salmon carcass freshness from September 26, 2017 to November 2, 2017.

Survey Period	Dates	Fresh	Non-Fresh	Total	%
1	Sep. 26 – 28	3	9	12	7%
2	Oct. 03 – 09	16	11	27	15%
3	Oct. 10 – 16	18	19	37	20%
4	Oct. 17 – 20	16	31	47	26%
5	Oct. 24 – 27	8	31	39	21%
6	Oct. 31 – Nov. 2	-	20	20	11%
Total		61	121	182	
		34	66		

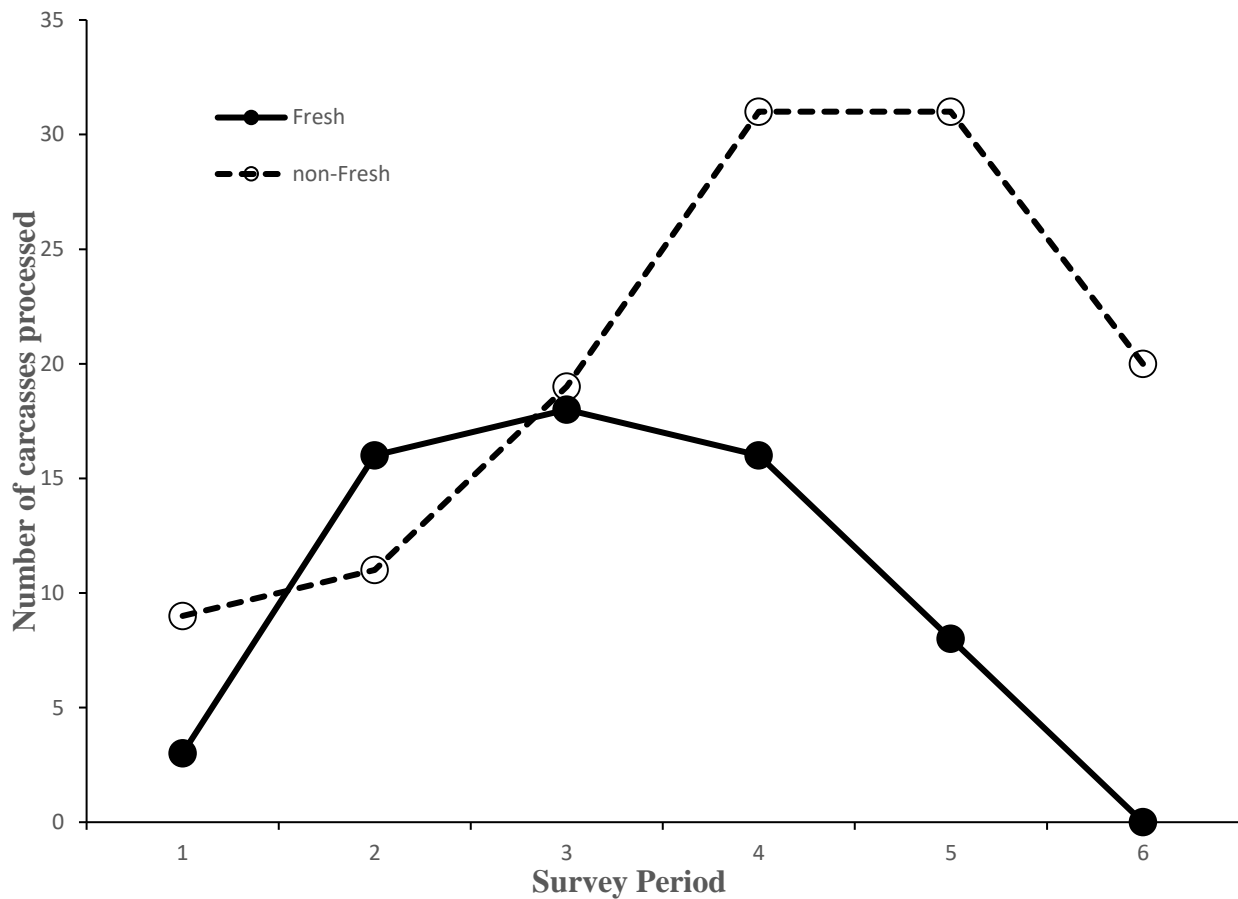


Figure 2. Temporal distribution of salmon carcass freshness from September 26 to November 2, 2017.

Spatial Distribution

The majority of carcasses observed occurred in sections C (28%, $n=51$) and D (22%, $n=40$). The least amount of carcasses observed was in the furthest downstream section of Covered Bridge to

Parrott-Phelan Diversion Dam (7%, $n=13$). Eighty-two percent of carcasses were processed between survey periods 2 and 5 (Oct. 3 to Oct. 27) (Table 5). Spawning distribution was fairly uniform across all reaches of the creek. The CJS population estimate after applying encountered carcasses to weekly intervals, estimated that 515 fish survived to spawn. Section C ($n = 144$) had the most spawning activity followed by Section D ($n = 113$) (Figure 3).

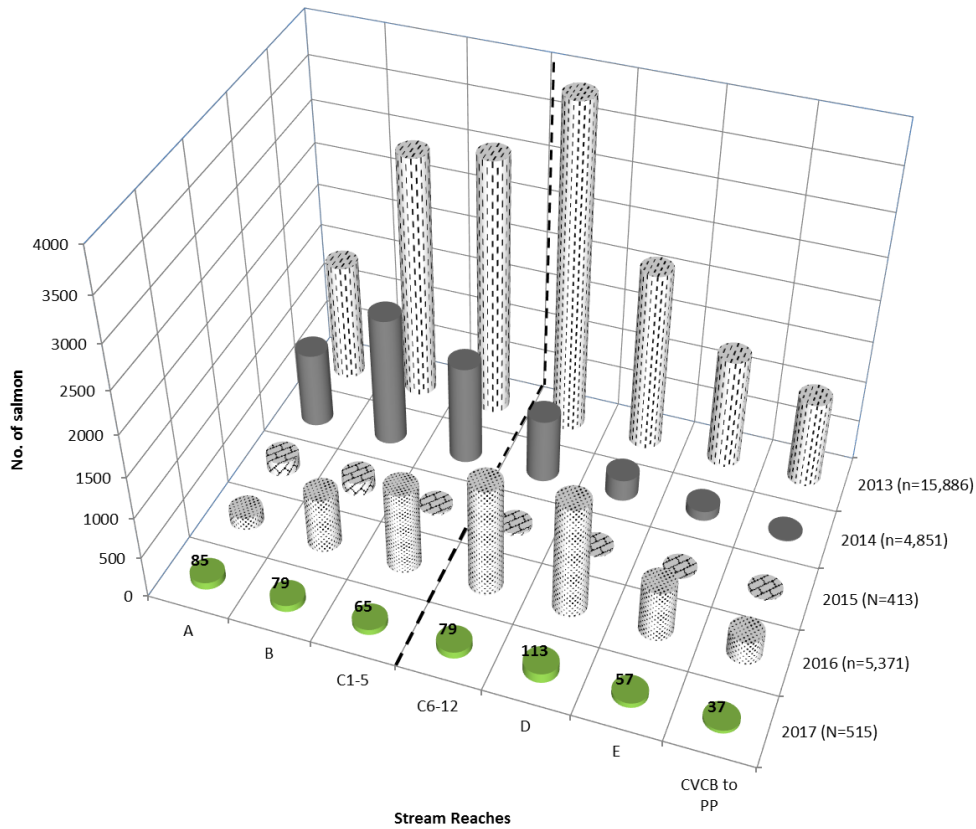


Figure 3. Spawning distribution by reach on Butte Creek compared among the years 2013 through 2017.

Table 5. Total salmon carcasses processed by survey section from September 26 to November 2, 2017.

Survey Period	Dates	A	B	C	D	E	COV-OKIE	Totals	%
1	Sep. 26 to Sep. 28	7	5	0	0	0	0	12	7%
2	Oct. 3 to Oct. 9	4	2	7	4	0	10	27	15%
3	Oct. 10 to Oct. 16	0	0	12	13	9	3	37	20%
4	Oct. 17 to Oct. 20	11	7	13	12	4	0	47	26%
5	Oct. 24 to Oct. 27	6	7	15	7	4	0	39	21%
6	Oct. 31 to Nov. 2	2	7	4	4	3	0	20	11%
Totals		30	28	51	40	20	13	182	100%
%		16%	15%	28%	22%	11%	7%	100%	

Length Composition

A total of 66 carcasses was processed for forklength (FL) and sex (Figure 3). Male carcass minimum and maximum FL were 510 mm and 1010 mm, respectively with a mean of 834 mm. Minimum and maximum FL for female carcasses were 495 mm and 900 mm, respectively with a mean of 741 mm.

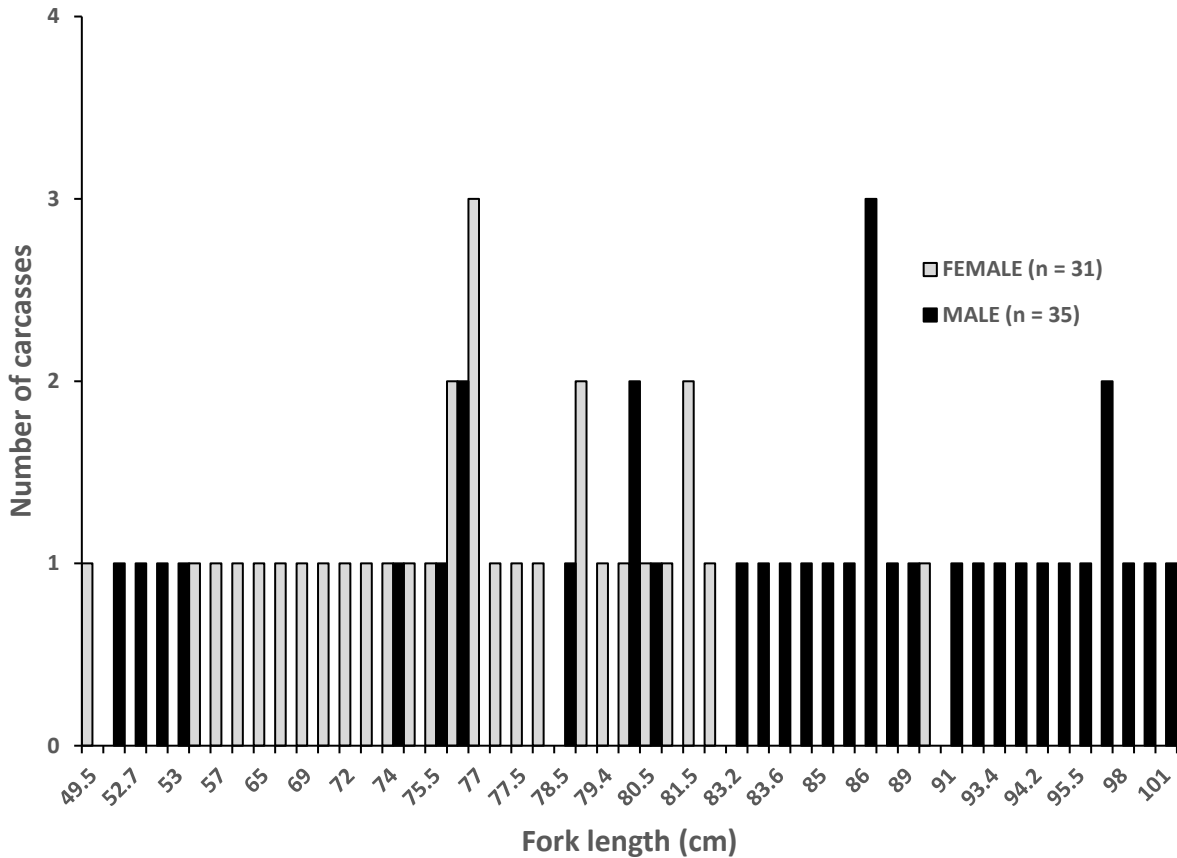


Figure 3. Salmon carcass fork length frequency distribution by sex from September 26 to November 2, 2017.

Sex Composition

A total of 182 carcasses was handled during the carcass survey of which 66 were processed for length and sex; 47% (n =31) were females and 53% (n = 35) were males (Figure 4). There were 116 carcasses that did not have sex or length recorded and were chopped in half on first capture (Table 6).

Table 6. Total salmon carcasses processed from September 26 to November 2, 2017.

Survey week	Date	Female	Male	Not Recorded	Total
1	Sep. 26 to Sep. 28	1	2	9	12
2	Oct. 03 to Oct. 09	7	11	9	27
3	Oct. 10 to Oct. 16	8	10	19	37
4	Oct. 17 to Oct. 20	8	10	29	47
5	Oct. 24 to Oct. 27	7	2	30	39
6	Oct. 31 to Nov. 2	0	0	20	20
TOTALS		31	35	116	182

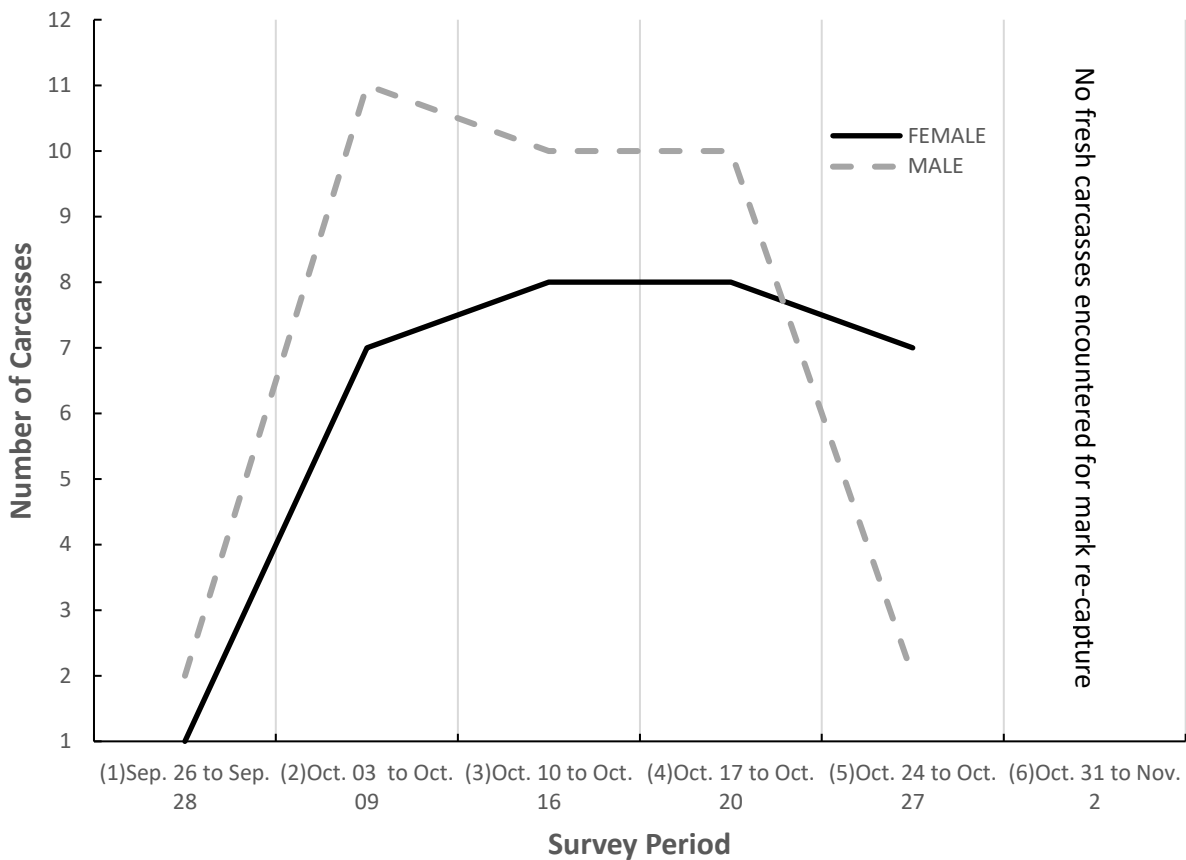


Figure 4. Total carcasses processed and identified by sex for mark re-capture from September 26 to November 2, 2017.

Population Estimate

The CJS population model was used to estimate the 2017 SRCS escapement (Bergman et al. 2012). Sixty-six salmon carcasses were disk-tagged for the mark-recapture study, and the total number of disk-tagged carcasses recaptured was 13. The SRCS escapement estimate for Butte Creek was **515**. With 90% bootstrap confidence intervals, total escapement is estimated to range between 375 and 6,806.

Environmental Conditions

Butte Creek water temperature decreased through a portion of the escapement survey then increased after a rain event in late October. The maximum and minimum recorded water temperatures at Quartz Bowl Pool were 8.5°C on October 13 and 12.8°C on October 28 and 29, with an average temperature of 10.5°C (Figure 6). Butte Creek flows remained fairly constant throughout the spawning period with the exception of a rain event on October 20, 2017 which increased flows to a maximum of 156 cubic feet per second (cfs). Minimum flows were 101 cfs on October 9, with an average flow of 110 cfs (Figure 5).

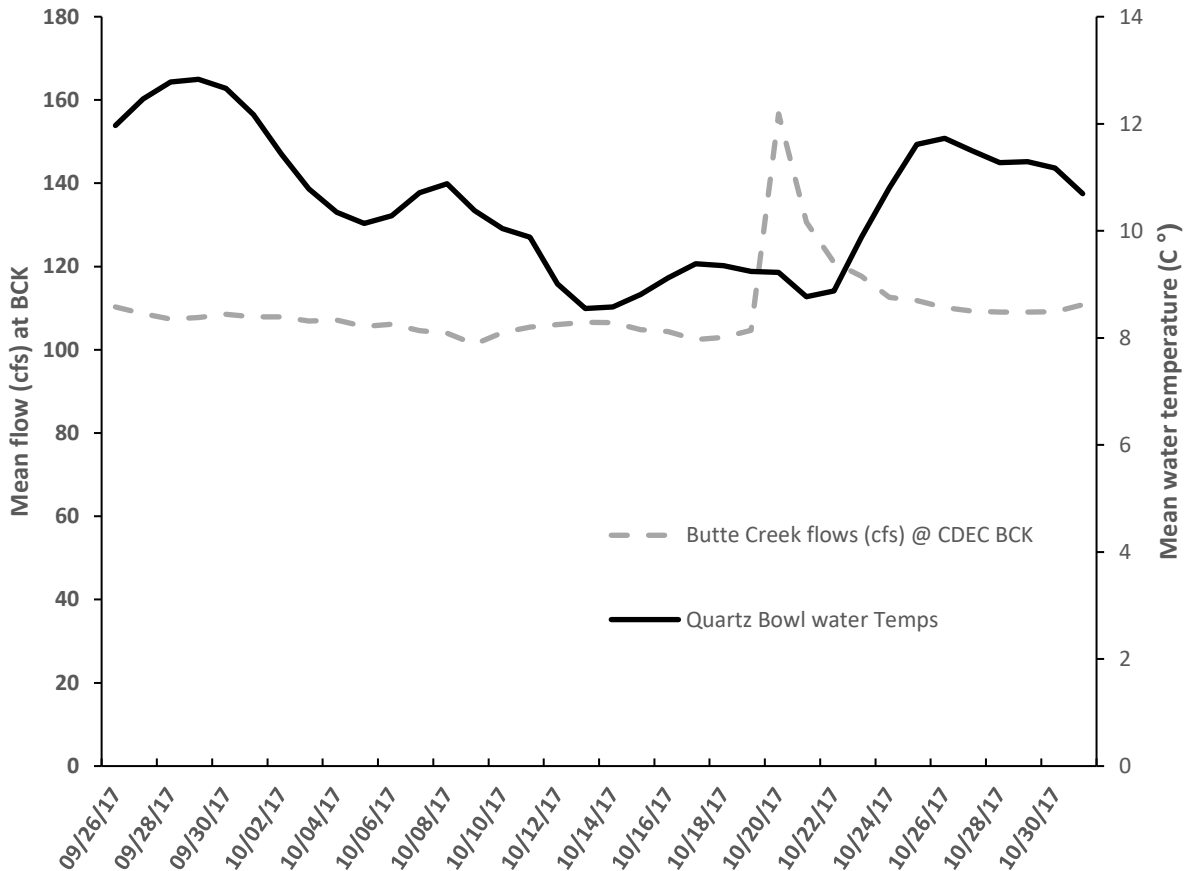


Figure 5. Mean daily river flows and mean daily water temperatures observed during the 2017 Butte Creek carcass survey.

Conclusions

Environmental conditions likely played a role in influencing the final escapement estimate of spring-run Chinook salmon in Butte Creek for the 2017 spawning season. Over an inch of rain occurred on 19 October 2017 and flows subsequently increased to 156 cfs. ‘Wash out’ events do not typically occur during the SRCS spawning season on Butte Creek. Though flows quickly recede to base flow levels, carcasses can be dislodged from their resting state and become dispersed into places outside the typical survey area resulting in low recovery rates of marked fish and low numbers of overall carcass detectability. This may help explain the discrepancy between the summer holding snorkel survey estimate of 982 versus the CJS estimate of 515. No

pre-spawning carcass survey was conducted for the 2017 holding period, therefore there is no way to discern if the discrepancy is from a summer holding mortality event emphasizing the importance of summer holding habitat monitoring. It should also be noted that with such a small sample of carcass data input into the CJS Superpopulation model, model results generate a population estimates with a wide disparity in population sizes and confidence interval variation is great evidenced by the wide range of estimated escapement of 375 and 6,806 (when incorporating confidence intervals).

Acknowledgments

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LITERATURE CITED

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