State of California
The Resources Agency
DEPARTMENT OF FISH AND GAME

Results of the 2007 Cow Creek Video Station Fall-Run Chinook Salmon Escapement

By
Douglas Killam
California Department of Fish and Game, Northern Region
Sacramento River Salmon and Steelhead Assessment Project

SRSSAP Technical Report No. 08-2
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1/

Cover Photo: View looking downstream through the fish passage opening of the 2007 Cow Creek Video Station

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1/ This was a cooperative investigation between the California Department of Fish and Game (Department), the U.S. Fish and Wildlife Service's Red Bluff Fish and Wildlife Office (Service) the Western Shasta Resource Conservation District (WSRCD), and the Cottonwood Creek Watershed Group (CCWG). It was supported by funding from the Sport Fish Restoration Act Grant F-51-R-18 Project 57-(Department), and the Anadromous Fisheries Restoration Program.

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SUMMARY

This report provides second year results of the fish counting video station operated on Cow Creek in Shasta County California to estimate fall-run Chinook salmon numbers. The California Department of Fish and Game in cooperation with the Western Shasta Resource Conservation District, the U.S. Fish and Wildlife Service, and the Cottonwood Creek Watershed Group collaborated to conduct an escapement estimate of fall-run Chinook salmon, *Oncorhynchus tshawytscha*, in Cow Creek using overhead video monitoring. A video camera suspended above Cow Creek was used in conjunction with a partial weir to record the passage of upstream migrating salmonids from 20 September through 06 December 2007.

An estimated 2,044 salmon entered into Cow Creek in 2007 based on the video station counts. Initial counts were adjusted for missing time periods and also as a result of a QC process that checks the original counts.

The number of fall-run salmon in Cow Creek represented 2.2% of the total spawner escapement to California's Central Valley in 2007.

Future use of the video station would provide an annual estimate escapement of fall-run Chinook salmon in Cow Creek. Use of similar stations may provide opportunities to easily monitor salmon escapement in other Central Valley streams that have no current monitoring programs due to staff or budget limitations, landowner permission, or inaccessible spawning areas.

INTRODUCTION

A video station was used to count fall-run Chinook salmon (fall-run) escapement into Cow Creek, (Shasta County, California), from 20 September through 06 December 2007. The station was constructed and operated cooperatively by the Red Bluff Sacramento River Salmon and Steelhead Assessment Project of the California Department of Fish and Game (Department), the Western Shasta Resource Conservation District (WSRCD), The Cottonwood Creek Watershed Group (CCWG), and the Red Bluff Fish and Wildlife Office of the U.S. Fish and Wildlife Service (Service). Funding for this project was provided in part by a Sport Fish Restoration Act (SFRA) Grant (Department) and by the Anadromous Fish Restoration Program (Service, WSRCD, and CCWG).

Objectives

- To obtain an estimate of fall-run escapement into Cow Creek.
- Continue collection of baseline data on salmon escapement that can be used to evaluate restoration activities occurring in the Cow Creek watershed.

Background

Well-designed environmental monitoring programs are needed to provide information to guide sound decision-making processes for natural resource management in California's Central Valley. In the Cow Creek watershed of the upper Sacramento River, reliable resource monitoring information is important to guide decisions and evaluate actions associated with an ecologically important watershed. Reliable data on salmon escapement in Cow Creek are needed to interpret fishery responses to habitat restoration activities, and provide information to fisheries managers, landowners, and others interested in the Cow Creek watershed.

The Cow Creek watershed encompasses 275,000 acres and contains 6 major tributaries. Combined, these tributaries total 164 miles of stream channel (WSRCD, 2005). The watershed is home to a variety of fish species including steelhead, Chinook salmon, and native cyprinids. In 2005 the Cow Creek Watershed Plan identified the lack of data on resident and anadromous fish populations and recommended that studies collecting baseline population data be implemented (WSRCD, 2005). The video station on Cow Creek serves this need and also the need of government fisheries agencies to have accurate population stock assessment for management of coast wide fisheries resources (i.e. ocean and in-river harvest management needs).

Prior to 2006 the Department had not monitored fall-run escapement into Cow Creek on a consistent basis since 1969. Table 1 provides a summary of Cow Creek fall-run escapement from 1953 to present. From 1953 to 1969 fifteen annual estimates were made based on carcass counts and occasional aerial redd (salmon nests) counts (Department, Annual Reports 1956-2005). The carcass surveys involved crews walking in the creek counting spawned out salmon carcasses during the few weeks of the salmon

spawning season (October-November). Biologists would then expand the total carcasses counted based on their judgment of what percentage of the population they actually saw, (for example in 1957 six surveys reported 70 carcasses judged to be 10 percent of the population resulting in a 700 total fish population estimate). Carcass surveys today use a much more scientific methodology, but during the 1950's this "estimation by best judgment" was sufficient for management purposes.

Table 1. Summary of fall-run escapement numbers into Cow Creek from 1953 to 2007.

YEAR	Estimate	YEAR	Estimate
1953	3,000	**1981**	unknown
1954	4,500	**1982**	unknown
1955	1,300	**1983**	unknown
1956	3,200	**1984**	250
1957	700	**1985**	unknown
1958	3,300	**1986**	unknown
1959	680	**1987**	unknown
1960	650	**1988**	unknown
1961	unknown	**1989**	unknown
1962	1,500	**1990**	unknown
1963	unknown	**1991**	unknown
1964	1,000	**1992**	unknown
1965	1,000	**1993**	unknown
1966	7,600	**1994**	unknown
1967	520	**1995**	unknown
1968	7,540	**1996**	unknown
1969	5,570	**1997**	unknown
1970	unknown	**1998**	unknown
1971	unknown	**1999**	unknown
1972	unknown	**2000**	unknown
1973	unknown	**2001**	unknown
1974	unknown	**2002**	unknown
1975	unknown	**2003**	unknown
1976	726	**2004**	unknown
1977	unknown	**2005**	unknown
1978	unknown	**2006**	4,130
1979	unknown	**2007**	2,440
1980	unknown		
AVERAGE all years (1953-2007)			**2,611**
source Grandtab-Department			

Similar estimates were made using aerial redd counts when no carcass surveys were conducted (e.g. 1962). A pilot and an observer in a small plane would count the number of new salmon redds in the creek and this number would be expanded based on "best judgment". Most early estimates made with these techniques will often be reported as numbers rounded to the nearest hundred or thousand figures. In more recent years budget

constraints, staffing shortages, logistics and landowner trespass concerns have resulted in only two annual (1976, 1984) fall-run estimates being made for Cow Creek since 1969. This data is presented in Table 1 and is updated annually in the Department's electronic Grandtab file (available currently on the website: Calfish.org) that summarizes salmon populations in the California Central Valley.

The video station estimate in 2006 and 2007 represents a new method for estimating fall-run populations in Cow Creek. A similar video station was constructed and operated since 2003 in Battle Creek and was successful in replacing the traditional carcass survey on that creek. The data from the Battle Creek video station allowed biologists to compare the results of a carcass mark-recapture study and hatchery counts to the video station results (Killam, 2006). Over a three-year period the counts from the two independent methods were similar enough to give fisheries biologists the confidence to halt the labor intensive carcass survey, (in 2006 and 2007 the video station was the only method used on Battle Creek). As a result of the success in Battle Creek the video station methodology was approved for use in other watersheds.

In October of 2005 a description of the Battle Creek video station was presented at a meeting of the Cow Creek Watershed Group. At this meeting there was a general consensus that the group was interested in developing a video station on Cow Creek for the fall of 2006. As mediators for the group, the WSRCD arranged to coordinate the video station details with the Department and Service. In early November of 2005 a kayak survey of Cow Creek was made to choose a site for the new video station. A single site just upstream of the Dersch Road Bridge fit all the criteria for a video station. Criteria for the video station site included:

1. Limited public access to avoid vandalism and poaching opportunities.
2. A nearby power supply to run the station's VCR's and cameras.
3. Close to the mouth of Cow Creek so that all/most salmon would spawn above the site.
4. Landowner permission to construct and access (daily) the video station site.
5. Suitable stream geology to place the weir (shallow with even stream bottom)

The chosen site was located approximately 1.3-miles (2 kilometers) upstream of the mouth of the Sacramento River (Figure 1). The station recorded the passage of fall-run salmon during most of their upstream migration period (early-September through mid-November). Personnel from the Department, the WSRCD, the CCWG, and the Service cooperated to accomplish station set-up and removal, maintenance, tape changes, tape reading and quality control of tape reading.

METHODS and MATERIALS

The video station is comprised of two groups of equipment, these included:

- Power supply(s), camera, lights, and video cassette recorders (VCR's)

- Weir, camera support cables VCR lock box and the fish passage plates on the stream bed.

Each of these groups of equipment is described in detail in the 2006 Cow Creek report, (Killam, 2007) and is not described in this report. Changes to the station's equipment that were made in 2007 are described below. The Cow Creek 2006 report is available online at: http://www.calfish.org/IndependentDatasets/CDFGRedBluff

The following are modifications made to the station in 2007:

- White high density polyethylene (HDPE) sheets were staked to the creek bottom to make the observation of passing salmon easier. Two overlapping ¼ inch by 4 by 10 feet (6 mm x 1.2 m x 3 m) sheets were used to create a white background (see report cover photo). These plates had ¾-inch (19 mm) holes drilled around their perimeters to allow staking. A metal frame plate was bolted to the upstream edge of both plates prior to placement in the creek. The entire assembly was then staked to the streambed underneath the camera. Stakes were 24 inch concrete form stakes with a 2-inch (50mm) washer welded to their tops to secure the plates. (*Note, in 2006 white plates were 8 x 4 feet and no frame plate*)

- An underwater housing from PVC pipe fittings and operated an underwater camera (Type PC88-WR similar to overhead camera) at the lower edge of the weir opening to aid in species identification. This underwater camera was also used to check passing salmon for adipose fin clips (hatchery origin). (*Note, not available in 2006*)

- The image from the cameras was inputted into a color quad processor (Supercircuits type QS-29) that merged the underwater camera image with that of the overhead camera onto one image (picture in picture mode). This image was then inputted into four VCR's. Three of the VCR's (Sony type SLV-D380P) were programmed to sequentially record eight hours periods, thereby providing 24-hours of continuous coverage each day. Video tapes were type T-160, set to record on extended play (EP) mode. A fourth "time-lapse VCR" (Ganz type CTR-030NC-2) was programmed to record 4-hours each day at the end of the third 8-hour cycle. *(Note, new VCR type and quad processor was not available in 2006)*

- A measuring device was constructed to allow tape readers to approximate the length of passing fish. A metal rectangle measuring 24-inches (61 cm) tall by 12-inches (30 cm) wide allowed tape readers to approximate fish lengths, (see cover photo). This "station brand" was custom welded (by author) from 3/8-inch (9.5 mm) rebar and incorporated the letters C and W into the center of the design to identify tape images as those belonging to Cow Creek during future viewing. (*Note, not available in 2006*)

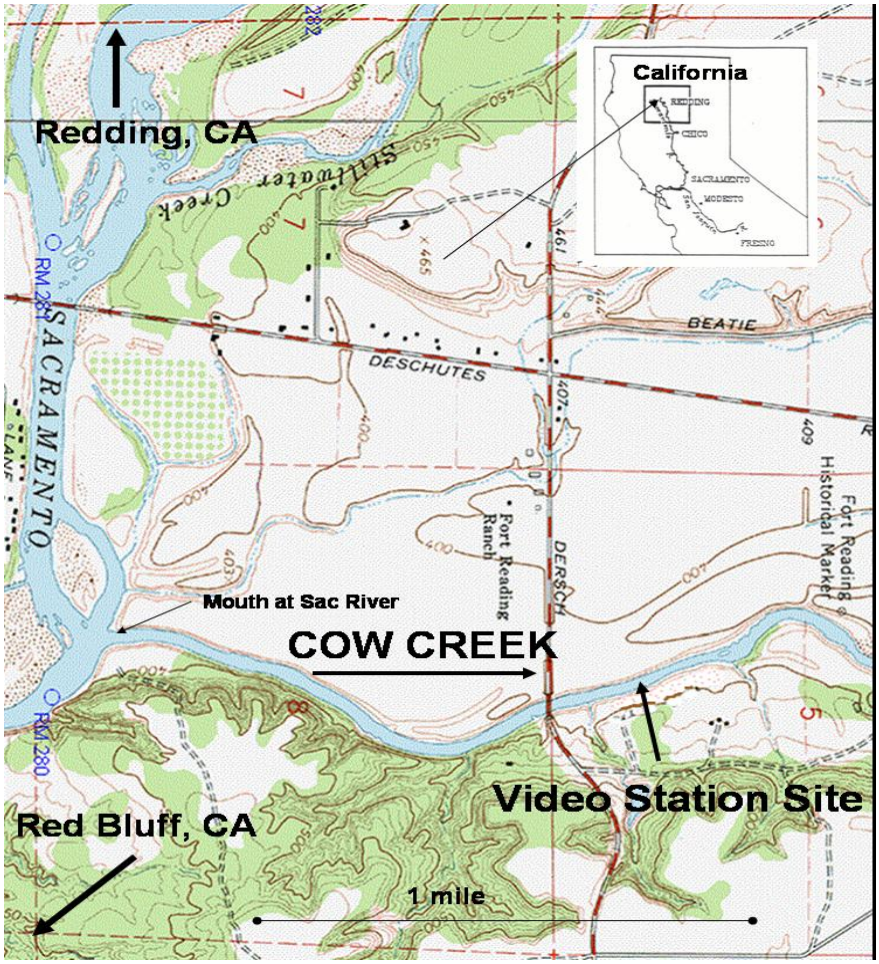

Figure 1. Map detailing the location of the video station on lower Cow Creek.

Video station operation and maintenance

The video station was checked once a day during operation. Daily activities included:

- Changing videotapes in the three daily VCR's.
- Checking power levels and normal operation of equipment (lights, VCRs, etc).
- Cleaning the weir and white plates of algae, debris, and carcasses.
- Recording comments and time of visit in the station logbook.
- Transporting video tapes to SRSSAP for processing and analysis.

Fish Counting Procedures

Tapes were played on VCR's that outputted into a Honeywell Fusion III digital video recorder (DVR). During periods of clear water, motion detection software was utilized to detect motion in the area of the white plates. The motion detection software eliminated periods of time when no fish were passing. During periods of turbid water the DVR software was set to record continuously for later analysis by staff. After the VCR tapes from the station were finished playing they were rewound and stored. The DVR software

was then used by staff from the WSRCD and the Department to access the digital files containing the motion filtered and continuous recordings.

Each date was divided into 48 half-hour periods. The number of salmon passing upstream of the white plates was tallied on a datasheet for each period. There were categories for both up and down passing salmon. In some instances, salmon spawning adjacent to the weir area will actively pursue other salmon both up and down through the opening while defending their spawning area. Counters tallied the downstream fish as well as the upstream fish. Downstream passing salmon were subtracted from the upstream total for each period to maintain an accurate total upstream count.

Datasheets were transcribed into a Microsoft Excel file. The electronic Excel file was used to organize the data. Passage data was then transferred into a Microsoft Access file where it was analyzed by different categories of interest to readers. Categories included: passage by date, time, month and week. Also included in the Access file was analysis for the quality control check.

Quality Control Checks of Fish Passage Counts

Quality control (QC) checks on all half-hour periods with fish passage counts greater than nine were made by Department personnel. If counts for these periods were different from the original "reads" then a third count was made to determine a final count. Periods with less than 10 fish passing were stratified by initial reader and by two types of counts: Type 0 was = 1 or less fish and Type 1 was = 2 to 9 fish. A random sub sample of periods was chosen from these counts and these periods were QC reviewed by Department staff. An adjustment factor was created for each stratum (reader and type) to adjust all Type 0 and Type 1 counts (not just the QC reviewed periods). The adjustment factor was the percent difference between the sum of the total stratum QC counts and the sum of the total stratum original counts (within the sub sample). The adjustment factor and original counts were multiplied (for each stratum) to determine a "final QC" count. This count is summed for each period to calculate the total salmon passage for the station.

RESULTS and DISCUSSION

Data Results

The final adjusted estimate of fall-run Chinook salmon that went into the Cow Creek watershed in 2007 was **2,044**. The daily passage data for the video station is presented in Table 2. Peak passage occurred on 10 October corresponding to a water temperature of sixty-degrees Fahrenheit, (15.6^{o}C). The total passage estimate was 2,038 counted upstream of the station. The total in Table 2 includes six downstream spawners that constructed redds immediately downstream of the station site.

Table 3 presents the data by half-hour periods revealing that the peak of migration at the video station site occurred at 10:00 in the morning and also at 16:30 in the afternoon. The 2007 results in Table 3 differ from the results in 2006 on Cow Creek and for other

salmon monitoring stations. In 2006 the Cow Creek peak passage occurred at 7:30 in the morning and at 19:00 in the evening (Killam, 2007). The 2006 results are typical for other creeks (e.g. Battle Creek) and it is not known if the pattern in 2007 was the result of any specific factor (e.g. passage difficulties downstream due to low flows), or is just a normal fluctuation of timing patterns on Cow Creek.

Table 2. Summary of daily passage for fall-run Chinook salmon, Cow Creek flows (cfs), and water temperature at the 2007 Cow Creek video station.

Date	Passage	Cumulative Percent	Flow (cfs)	Water Temp	Date	Passage	Cumulative Percent	Flow (cfs)	Water Temp
20-Sep	0	0.0%	34	67	29-Oct	32	81.0%	80	58
21-Sep	0	0.0%	38	68	30-Oct	10	81.4%	79	60
22-Sep	0	0.0%	34	67	31-Oct	33	83.1%	84	60
23-Sep	0	0.0%	41	67	1-Nov	37	84.9%	81	59
24-Sep	0	0.0%	49	67	2-Nov	8	85.3%	80	57
25-Sep	0	0.0%	39	67	3-Nov	4	85.5%	78	56
26-Sep	0	0.0%	36	67	4-Nov	20	86.4%	76	55
27-Sep	0	0.0%	37	68	5-Nov	21	87.5%	72	54
28-Sep	0	0.0%	36	66	6-Nov	30	89.0%	72	54
29-Sep	2	0.1%	47	62	7-Nov	21	90.0%	76	54
30-Sep	4	0.3%	48	62	8-Nov	8	90.4%	75	53
1-Oct	0	0.3%	50	65	9-Nov	12	91.0%	76	54
2-Oct	0	0.3%	48	64	10-Nov	30	92.4%	78	54
3-Oct	2	0.4%	43	64	11-Nov	21	93.5%	101	54
4-Oct	0	0.4%	41	63	12-Nov	23	94.6%	99	53
5-Oct	41	2.4%	49	61	13-Nov	11	95.1%	88	55
6-Oct	13	3.0%	51	59	14-Nov	7	95.5%	85	55
7-Oct	8	3.4%	51	60	15-Nov	16	96.3%	83	55
8-Oct	32	5.0%	48	61	16-Nov	5	96.5%	83	56
9-Oct	115	10.7%	50	60	17-Nov	8	96.9%	87	57
10-Oct	**581**	39.2%	88	60	18-Nov	5	97.1%	85	57
11-Oct	250	51.4%	100	58	19-Nov	15	97.9%	89	57
12-Oct	45	53.6%	100	58	20-Nov	7	98.2%	121	53
13-Oct	6	53.9%	97	59	21-Nov	2	98.3%	99	50
14-Oct	6	54.2%	85	61	22-Nov	6	98.6%	89	48
15-Oct	14	54.9%	78	60	23-Nov	0	98.6%	84	46
16-Oct	13	55.5%	159	58	24-Nov	0	98.6%	84	45
17-Oct	117	61.2%	185	57	25-Nov	1	98.7%	85	45
18-Oct	62	64.3%	138	58	26-Nov	3	98.8%	83	45
19-Oct	72	67.8%	229	58	27-Nov	6	99.1%	84	46
20-Oct	48	70.2%	**501**	57	28-Nov	1	99.1%	84	46
21-Oct	10	70.7%	186	55	29-Nov	4	99.3%	82	45
22-Oct	12	71.3%	128	57	30-Nov	2	99.4%	82	44
23-Oct	25	72.5%	109	58	1-Dec	0	99.4%	83	**41**
24-Oct	38	74.3%	102	59	2-Dec	0	99.4%	83	41
25-Oct	45	76.6%	96	59	3-Dec	0	99.4%	88	44
26-Oct	26	77.9%	85	57	4-Dec	4	99.6%	271	47
27-Oct	21	78.9%	86	57	5-Dec	5	99.9%	218	48
28-Oct	10	79.4%	83	58	6-Dec	2	100.0%	202	48
					Totals	**2,044**			

Table 3. Summary of fall-run Chinook salmon passage by time of day at the 2007 Cow Creek video station. Peak passage was at 10:00 in the morning and a second peak was observed at 16:30 in the evening.

Time	Passage	Time	Passage
0:00	34	12:00	49
0:30	38	12:30	58
1:00	31	13:00	71
1:30	20	13:30	64
2:00	39	14:00	41
2:30	36	14:30	37
3:00	24	15:00	65
3:30	23	15:30	80
4:00	17	16:00	85
4:30	30	**16:30**	**109**
5:00	18	17:00	83
5:30	12	17:30	51
6:00	19	18:00	53
6:30	8	18:30	24
7:00	26	19:00	37
7:30	7	19:30	37
8:00	11	20:00	27
8:30	34	20:30	31
9:00	70	21:00	26
9:30	74	21:30	17
10:00	**113**	22:00	30
10:30	85	22:30	29
11:00	53	23:00	29
11:30	60	23:30	21

Table 4 provides count data each month and for each week. The data in Table 4 reveals that the peak passage for the fall-run at Cow Creek occurred in October, with the most fish passing in the second week of this month. This was generally similar to the other video monitored tributaries (Cottonwood and Battle, (Bear peak was third week)) in the Upper Sacramento River Basin in 2007. Peak passage can vary a few weeks between years and waterways depending on the weather and type of year, (temperature and rainfall). Spawning would probably have commenced 1-2 weeks after passage so peak spawning activity in Cow Creek may have occurred in late-October through early-November. The data in the first and last week of Table 4 are partial counts since the station was in operation only some portion of these weeks.

A comparison of video station results for 2006 and 2007 is provided in Figure 2. The data in Figure 2 reveal that the peak of salmon passage into Cow creek in 2007 was earlier than in 2006, and also that the total number of salmon was much lower in 2007 than in 2006. This is not surprising as the total fall-run escapement to the Central Valley

in 2007 was the second lowest on record since record keeping began in 1952 (Department, Grandtab). What is of note is that despite the near record low returns, Cow Creek was second only to Clear Creek for numbers of salmon on non-hatchery tributaries in the Upper Sacramento River Basin.

Table 4. Summary of fall-run Chinook salmon passage at the 2007 Cow Creek video station. Data indicates that most salmon passed in the second week of October.

Month		Passage
September		6
October		**1,687**
November		334
December		11
Week	**Passage**	**Week Starts**
38	0	16-Sep
39	2	23-Sep
40	60	30-Sep
41	**1,037**	**7-Oct**
42	332	14-Oct
43	178	21-Oct
44	134	28-Oct
45	142	4-Nov
46	91	11-Nov
47	35	18-Nov
48	17	25-Nov
49	11	2-Dec
Total	**2,038**	

Data Adjustments

The 2007 video station estimate began as a count (n = 1,773) of all salmon (including adults and grilse) passing the station up to the time of weir removal on 06 December 2007. This count was for only those time periods where tapes were available. The video count was further adjusted to account for a number of factors that both raised and lowered the final estimate. This adjusted estimate included adjustments for periods when:

1. The taping malfunctioned (subtracted one salmon for one missing hour).
2. The water was too muddy to count fish (added 79 salmon for 69 turbid hours).
3. Three redds were observed downstream of the station site (added 6 salmon).
4. The QC process of tape reading (added 187 salmon to the total count).

The first two adjustments are made to the database under the assumption that salmon would have been passing had the station been operating efficiently during the "problem" periods. There were 4 separate turbid water adjustments totaling 69 hours (out of a total of 1,843 hours of operation or 3.7%). Two of these were in October and contained the

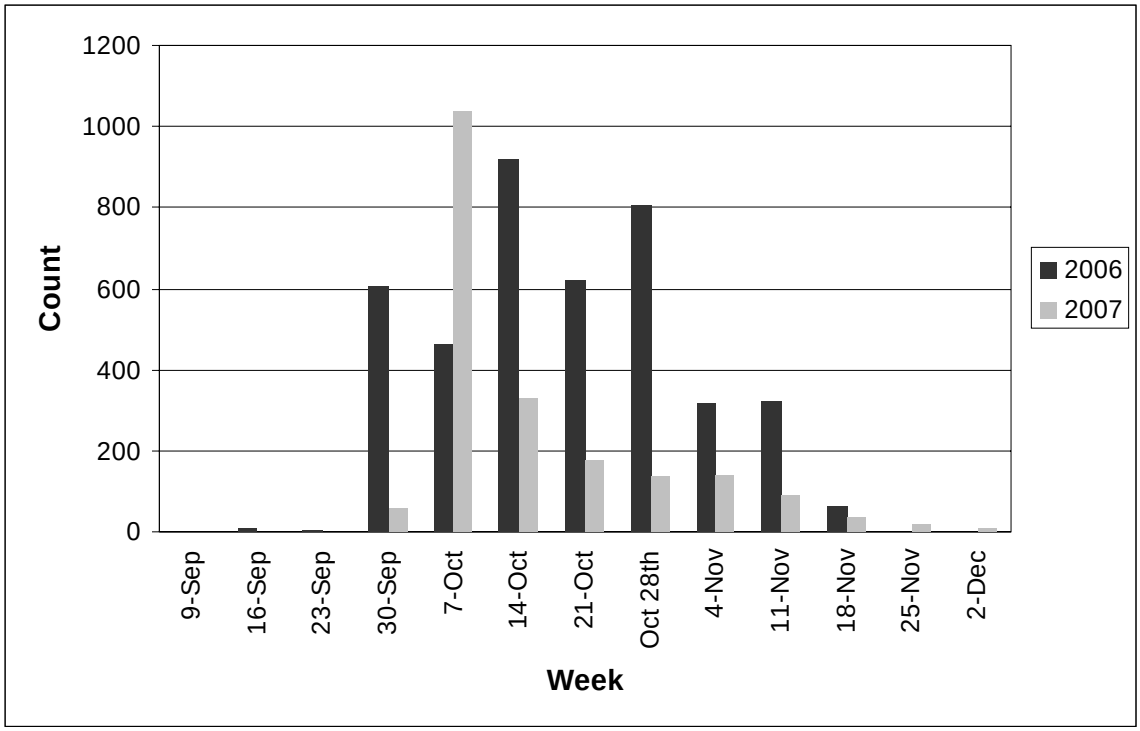

Figure 2. Chart comparing fall-run Chinook salmon counts by week at the Cow Creek video station for years 2006 and 2007.

majority (75) of the added fish. The other two periods were in December and added a total of only four salmon since most fall-run salmon had already passed by this late date.

Turbid periods are typically the result of rain events and the corresponding high flows. Table 2 lists average flows by date (obtained via the internet (CDWR 2007) from the permanent stream gauge near Millville, CA (CA. Data Exchange Center Station (CDEC): COW)) and allows comparison to fish passage and flow events. Note that the station was removed on 6 December as a result of a predicted large storm. The average flow on Cow Creek on 7 December was 1,103 cubic feet per second so the station was removed one day prior to possible damaging flood flows.

The goal for all the video stations, prior to installation in 2007, was to operate (includes all stations: Cow, Bear, Battle and Cottonwood) through at least 1 November. Any operation after this date is considered a "bonus period" and careful attention is paid to the weather. At any time, when a major storm was forecast, a decision to remove the weir had to be considered. Concern for damage or loss of the weir and other in-stream equipment dictates that weather forecasts were closely observed during station operation. The first of November was used as a goal because experience has shown that the majority of fall-run Chinook in Battle and Cow Creeks have already passed by this date (Killam 2006, 2007). For Cow Creek, Table 2 indicates that in 2007 over 83% of the total passage had occurred by this date. After 1 November a major predicted storm would

likely have resulted in station removal due to possible flooding. In 2007, no major storms occurred until early December.

During periods of turbid water an average of pre and post event passage is typically used to calculate the missing counts. Past experience with video stations has shown that rain events associated with muddy water can trigger a migratory response in fall-run. As a result, calculations that include pre and post-event counts likely provide conservative estimates for these missing periods.

Quality Control Checks of Fish Passage Counts

The quality control process resulted in the addition of 187 salmon added to the total count. Table 5 provides a summary of the adjustment factors that were generated by the QC process. Five readers participated in the original tape reading. One reader (reader 7 with the WSRCD) did the majority of the reading. The other readers assisted reader 7 in completing the tape reading. All periods above a count of nine (Type 2 = 22 periods (between 10-19) and Type 3 = 16 periods (greater than 19 fish) were reviewed during the QC process. The QC count for these periods was used as the final count if they were different from the original counts. The adjustments for these types in Table 5 are for reader informational purposes only. A random sample of 76 (2.5% of total) Type 0 periods, (1 or less fish), and 52 (22% of total) Type 1 periods (2 to 9 fish) were reviewed for accuracy. Table 5 presents the results of these QC checks stratified by type and reader. The adjustment factors in Table 5 were multiplied to each Type 0 and Type 1 original count made by the associated reader to determine the final count. (Note the calculated counts were not adjusted (i.e. turbid water)).

Table 5. Results of the original tape reading fish counts compared to the quality control (QC) fish passage counts (summed) for selected periods for the 2007 Cow Creek video station.

Reader	Count Type	Original Total	QC Total	Adjustment
1	0	0	0	0
1	1	2	2	0
6	1	4	4	0
7	0	11	21	0.91
7	1	180	188	0.04
7	2	257	261	0.02
7	3	511	515	0.01
8	0	0	0	0
9	0	0	0	0
9	1	7	5	-0.29
9	2	23	23	0

Use of the DVR to Read Tapes

The Honeywell Fusion II DVR was a useful addition to the video station equipment. The DVR allowed simultaneous recording of 9 VCR's to be inputted into the DVR. This allowed the tapes from Cow Creek (as well as Bear and Cottonwood stations) to be recorded digitally in an almost real-time fashion. The three daily tapes from the station were taken to the SRSSAP office and recorded simultaneously onto the hard drive of the DVR. The DVR was connected to 3 office VCR's allowing the recording of a 24-hour period to be finished in eight hours. The software design and motion detection capabilities of the DVR resulted in a significant (i.e. greater than 75% in some cases) reduction of the time it took to review tapes as compared to viewing them on a standard VCR.

The DVR software allowed multiple readers to view recorded video simultaneously. In addition the software allowed viewing the digital files at remote locations by copying the files to an external hard drive and installing the software on a computer at the WSRCD office. In this way the staff at the WSRCD was able to read the tapes at their convenience. The software also allowed readers to view tapes without having to handle tapes or push buttons to rewind or fast forward to periods of fish passage. All previous tape reading functions that were done on a VCR were now done within the framework of the DVR software and the click of a computer mouse. The DVR also allowed tapes to be recorded at a variety of motion detection sensitivities.

Tapes were generally recorded using conservative motion detection sensitivities that resulted in many recorded periods with no fish passage. Some periods (slight turbidity, rain, etc) were also recorded with both continuous (complete recording) and with motion detection and the two types compared to "test" if the motion detection settings were missing fish passage events. The more conservative motion detection settings were found to capture all of the fish passage events during periods of ideal visibility. Staff found that during periods of turbid water or periods with excessive light reflection from rain or wind events that the motion detection did not function well. These periods were subsequently recorded continuously and the entire period was reviewed for passage events.

RECOMMENDATIONS

1. The video station proved to be a valuable and accurate tool in estimating salmon escapement into Cow Creek. The installation of similar stations on waterways currently unmonitored in the Upper Sacramento River Basin should be investigated.

2. The operation of the video station should be continued again in 2008 to estimate the escapement of fall-run salmon to Cow Creek.

3. The purchase of three low cost digital video recorders should be pursued to streamline the efficiency of station operations and replace the VCR and tapes.

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