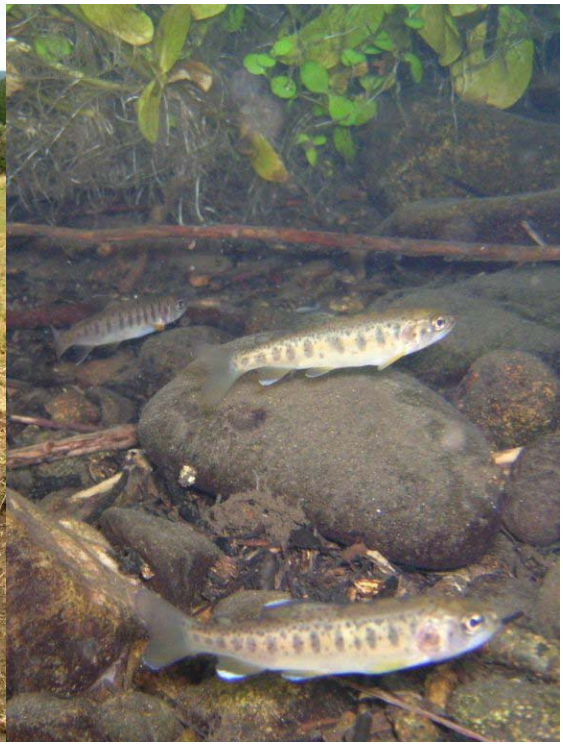
Monitoring Report - 2008
Scott River Water Trust

Prepared by Erich Yokel

Siskiyou Resource Conservation District
450 Main Street
P.O. Box 268
Etna, CA
96027

For the Department of Water Resources
Division of Planning and Local Assistance
Integrated Regional Water Management
Agreement #4600007711

Funded by Proposition 50

Table of Contents:

Acknowledgments:

Survey effort was performed and directed with the help of the following individuals:

Sari Sommarstrom – Consultant to the Scott River Water Trust – Principle - Sommarstrom and Associates
Mark Pisano – Cal. Dept. of Fish and Game
Bryan McFadin – North Coast Regional Water Quality Control Board
Joe Scott – Watermaster – Cal. Dept. of Water Resources
Gary Black – Siskiyou RCD
Danielle Yokel – Siskiyou RCD
Brannon Walsh – Siskiyou RCD
Kacey Munson – Siskiyou RCD
Bill Watrous – Siskiyou RCD

Rick Barnes - Landowner
Dick Dews – Landowner
Steve Edell and Nancy Burns – Landowner
Greg Farnam – Landowner
Rick Gilbert – Ranch Manager
Jim Morris - Landowner
Gareth Plank – Landowner
John Spencer – Landowner

Sari Sommarstrom contributed significant edits to the final version of the monitoring report. Mark Pisano contributed the succinct and clear questions that the monitoring activities sought to address.

Introduction:

The Scott River Water Trust (Water Trust) performed a series of transactions with adjudicated water users in the Scott River Watershed to forbear all or part of their diversion in the summer and fall of 2008. The Siskiyou Resource Conservation District (RCD) staff monitored water quality (temperature), quantity (stream discharge), fish habitat (pool volume), and fish presence (direct observation) before and after most of these transactions to document the effect on the instream habitat quality. The RCD performed monitoring activities with the Water Trust during the summer of 2007 and this initial experience was used to direct a more comprehensive monitoring program in 2008.

A variety of monitoring protocols were used to attempt to document the effect of the leased water on water quality, quantity and fish habitat. The main goal of this effort was to monitor the effectiveness of the Water Trust at a project level to improve the quality and quantity of available suitable aquatic habitat. The monitoring effort utilized protocols to monitor the physical habitat of the stream and documented the presence of the target species (coho and Chinook salmon) in the habitats affected by the transactions. The main objective of the monitoring effort was to answer the following questions while learning more about the hydrology and instream habitat availability in the Scott River Watershed.

Questions:

1) Was the amount of water paid for provided?
2) Was there an instream effect on stream discharge and/or pool volume below the lease site?
3) Was water temperature affected by leases?
4) Were target species in reaches affected by summer leases? Did fall leases aid the migration of adult Chinook salmon?

Methods:

The RCD developed a monitoring plan for the Water Trust with the assistance of Sari Sommarstrom (Consultant to Scott River Water Trust) and staff of the California Dept. of Fish and Game (Mark Pisano – Senior Fishery Biologist – Yreka) and the North Coast Regional Water Quality Control Board (Bryan McFadin – Water Resource Control Engineer). This plan - "Summary of Monitoring Activities for Water Trust Transactions – 2008" - was produced and reviewed in the spring of 2008. The document discusses protocols that will be performed and protocols that could be performed in the summer of 2008 or during future activities of the Scott River Water Trust.

Stream Flow – Stream flow (Q) was measured periodically at select pool tail crests above and/or below points of diversion that were participating in the activities of the Water Trust. Stream velocity was measured using a vertical axis current meter (USGS Pygmy Meter Model 6205 - Rickly Hydrological Company) with an AquaCalc Pro (JBS Instruments) data controller. Selected transects were broken into cells in which the depth and velocity was measured. The discharge of the individual cells (q) was kept to less than 5% of the entire discharge (Q) when possible by reducing cell size (Rantz, 1982). In some locations this desired condition ($q/Q<.05$) was impossible to meet due to low flows and/or a high percent of the flow occurring in the stream's thalweg.

A stream gaging station is operated by the USGS on the Scott River below Fort Jones (RM = 21). The California Dept. of Water Resources operates stream gaging stations on the lower reaches of Shackleford (RM = 0.7) and French Creek (RM = 0.9). The DWR Water Master verifies compliance with the Decrees of the Shackleford Creek and French Creek watersheds. The Water master was used to document water supply and actual volume of water diverted in these two watersheds.

The RCD operated three stream discharge gages in the Scott River during the fall transactions performed by the Water Trust. These gages were located on the Scott River below Youngs Dam (RM = 46.5), above Etna Creek (RM = 43.2) and above Serpa lane (RM = 35.1). These stream gages consist of an Onset HOBO Water Level Logger (U20-001-01) placed in a vented PVC tube attached to a staff gage and T-Post in the deepest section of a pool. The collected data was converted to river stage using "barometric compensation" in HoboWare Pro (Onset Computer Corporation). The RCD used the above Stream Flow methodology to develop rating curves for each gage allowing for the conversion of river stage data to discharge data (cubic feet per second (cfs) of water).

Stream Temperature – Water temperature was monitored continuously (15 minute or 1 hour interval) using Onset HOBO Water Temp Pro v2 Loggers during the period of the project. Temperature monitoring devices were placed in riffle habitats above and below the points of diversion of transactions to document the stream's temperature regime. Additional temperature monitoring devices were placed in pool habitats to determine if these habitats with greater depth and target species presence had a temperature regime different from the mixed waters of the riffle habitats. The water

temperature loggers were calibrated in both an ice and air temperature bath and the calibration data was analyzed to insure each device's accuracy. We attempted to place the devices in stream several days (24 hour periods) before the diverted water was placed in stream in order to collect sufficient data before treatment.

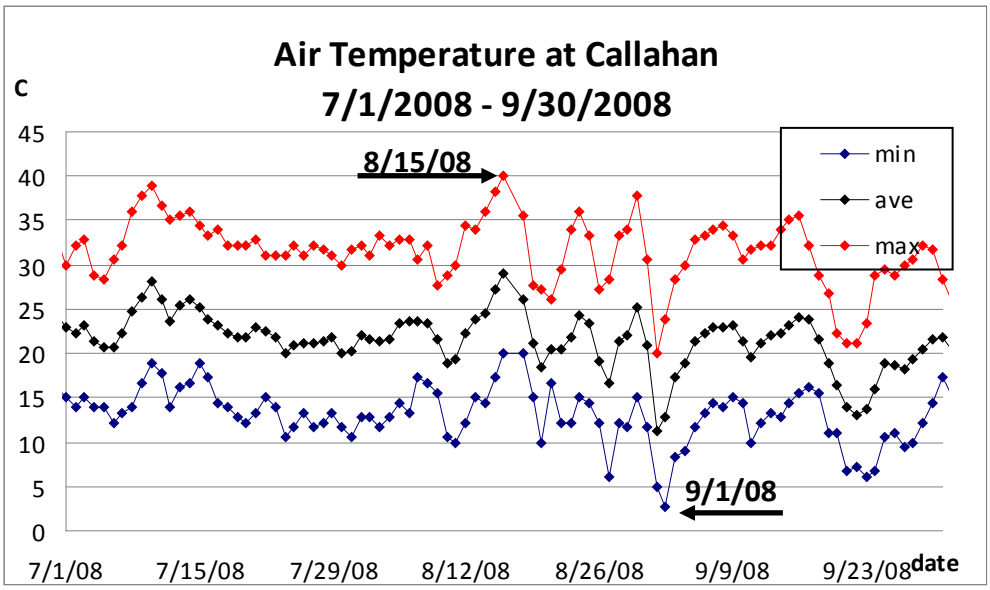
Periodic local stream temperatures and dissolved oxygen (DO) monitoring was performed with a calibrated hand held YSI 550A DO meter at locations with documented rearing juvenile salmon and observed differences in local stream temperature.

Pool Volume – The measurement of pool volumes before and after the Water Trust transactions was performed on two tributaries – Patterson Creek and Miners Creek. Pools above the point of diversion for the transaction (Control Pools) or pools below the point of diversion were identified before the transaction and a grid was established using five cross sections that were equally spaced from a random starting transect. A large nail (pin) was placed in each bank to denote the exact location in which measurements were to start for each transect and the "lay" of the transect. A series of twelve depth measurement locations were then established at an equally spaced interval between the wetted edges of the pool and the measurement locations were recorded. The water depth at these same twelve locations was measured for each of the five transects each time the pool volume monitoring was performed. The establishment of benchmarks that control the location of each of the sixty depth measurements for the determination of pool volume is a significant improvement over the pool volume monitoring effort of 2007. After the field measurements are performed the individual cell volumes are calculated and summed to estimate the pool's volume. Stream discharge measurements were performed in conjunction with every pool volume measurement.

Biological Surveys – The presence and relative density of the assemblage of anadromous salmonids (coho salmon (*O. kisutch*), Chinook salmon (*O. tshawytscha*), and rainbow trout (*O. mykiss*)) was documented using direct observation (snorkel survey) techniques before and/or after the transactions. Surveyors trained in species identification and direct observation techniques surveyed select meso- and micro-habitats to document the assemblage of fish present (Flosi, et al., 1998). Fish were enumerated by species and size class and habitat characteristics were qualitatively assessed and available volume was quantified through field measurements.

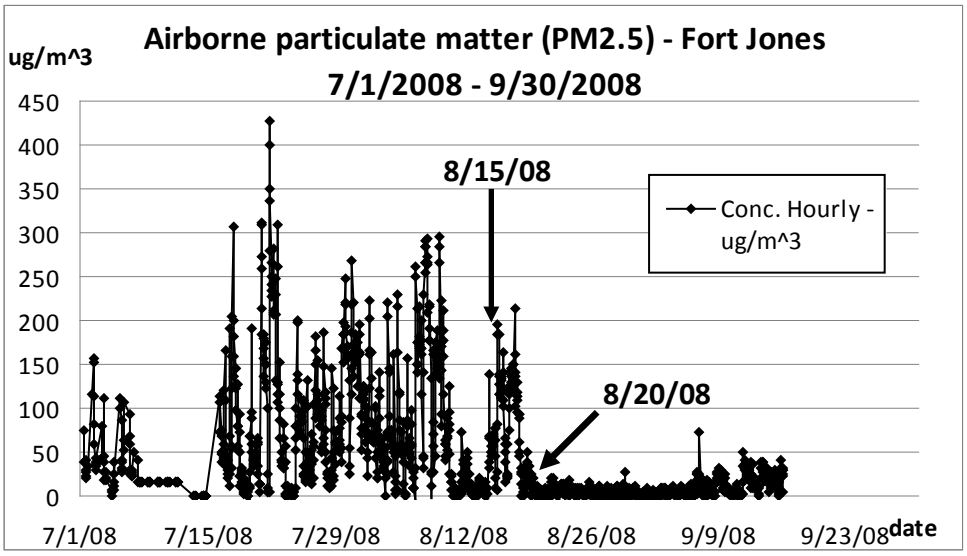
Environmental Conditions in the Scott Valley

Air temperature



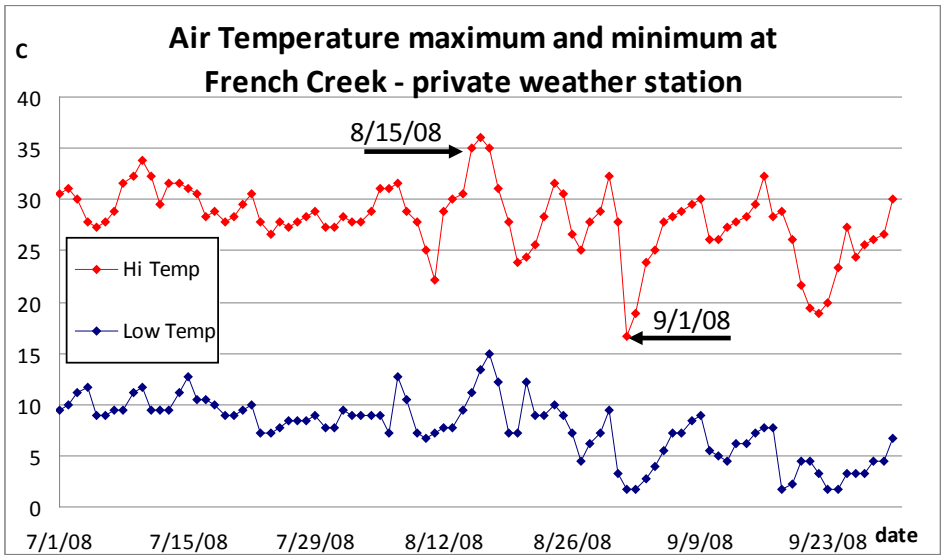
Graph 1 – Air temperature at U.S. Forest Service Station in Callahan – data retrieved from cdec.water.ca.gov on 1/12/2009.

The hourly air temperature was recorded at the U.S. Forest Service Station in Callahan in the southern end of the Scott Valley (Graph 1). Maximum daily (40.0° C) and average (29.0°) air temperatures were observed on 8/15/08 with a minimum of 2.9° C observed on 9/1/08. The majority of documented peak water temperatures correlated with the observed peak in air temperature on August 15th.



Graph 2 – Airborne particulate matter at Fort Jones

A series of forest fires were ignited in the vicinity of the Scott Valley during a lightning storm on June 22, 2008. These fires created significant amounts of smoke over the Scott Valley during July and early August. The hourly concentration of airborne particulate matter smaller than 2.5 µg (PM 2.5) was recorded at a station in Fort Jones (Unit 92) during the period of forest fires in the near vicinity of Scott Valley. Data was retrieved from the Interagency Real Time Smoke Monitoring Website (www.airsis.com) on 5/21/2009 and is displayed (Graph 2) to aid the interpretation of the factors affecting air and water temperature in the Scott Valley. High amounts of smoke were present in the Scott Valley from 7/16/2008 to 8/10/2008. A short period of low levels of smoke from 8/10/2008 to 8/14/2008 was interrupted by increased smoke on 8/15/2009 until 8/20/2009 at which point the smoke levels decreased dramatically.



Graph 3 – Daily air temperature minimum and maximum at a private weather station in French Creek

Daily air temperature minimums and maximums were recorded at a private weather station in the French Creek watershed above the confluence with the North Fork French Creek (Elevation – 3,000 ft.) - Graph 3. The maximum air temperature at this location was 36.1° C observed on 8/16/2008.

There was no precipitation recorded at the Callahan weather station during the period from 7/1/2008 – 9/30/2008. The weather station in French Creek recorded 0.28 inches of precipitation on August 19th, 2008. The weather station at the Fort Jones U.S. Forest Service station reported an accumulated total of 0.10 inches of rain for August 2008.

Summer Leases - 2008

Table 1 - 2008 Summer Lease Amounts by Scott River Water Trust

Stream / Tributary / Diversion Number	Date Began	Date Ended	Amount available (cfs)	Total acre-feet leased	Distance of benefit (ft.)
French Creek / Miner's Ck					
#33 – Initial --Added	7-29-08 8-16-08	9-30-08 9-30-08	0.20 0.20 to 0.10	44.0	7,000
#36	9-4-08	9-30-08	0.25	13.5	5,000
French Creek					
#48	7-10-08	9-30-08	0.70 to 0.40	88.0	1,300
Patterson Creek					
#390-10	7-2-08	9-30-08	0.5 to 1.0	71.4	2,000
Shackleford / Mill Ck					
#14	8-12-08	10-31-08	0.7	113.4	4,000
TOTAL				330.3 acre-feet	19,300 feet / 3.65 miles

French Creek

Diversion #48 - Lower French Creek (RM - 0.6)

Picture 1 – Representative habitat on lower French Creek with deep low velocity water and fish cover and shade from riparian vegetation.

Stream Flow Monitoring –

Picture 2 – Performing a discharge measurement with a current meter in lower French Cr. below Diversion #48

Stream flow monitoring on Lower French Creek was first performed on 7/9/2008 before the forbearance of 0.7 cfs from Div. #48 and for a series of days after the transaction occurred on July 10th (7/11 – 10/14/2008). Stream transects at a location above the point of diversion for Div. #48 (FRAB) and several locations below were identified for flow

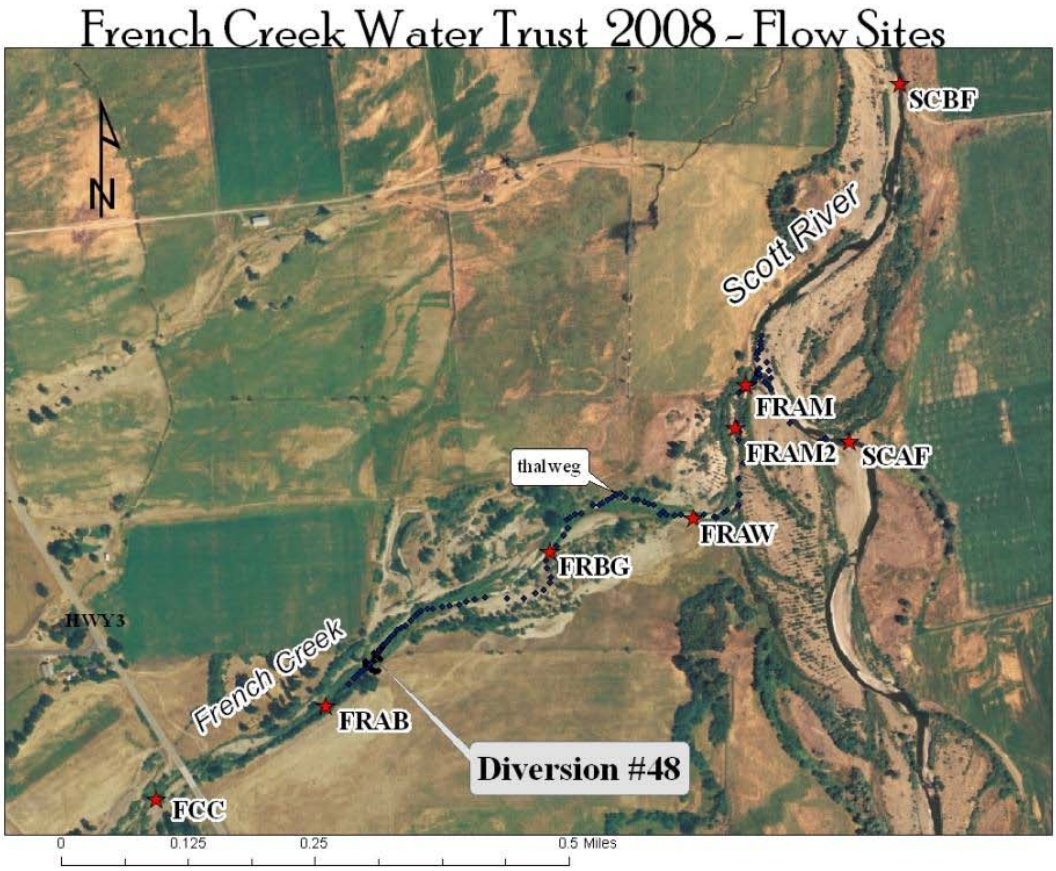
measurements during an initial survey of the reach. Multiple locations for flow measurements were identified and monitored downstream of the point of diversion because a suitable transect was not available before a portion of the instream flow went sub surface and the reach's complexity (e.g. areas with instream flow loss and gain) was identified. Table 2 shows the documented stream discharge throughout the survey season including certified data collected by the California Dept. of Water Resources at their gaging station located on French Creek above HWY3 (FCC). Map 1 illustrates the locations of the flow monitoring sites.

Scott River Water Trust - Lower French Creek Stream Flow Monitoring

	RM	7/9/2008	7/11/2008	7/28/2008	8/13/2008	9/12/2008	10/14/2008
DWR - French Creek above HWY3 (FCC)	0.85	**7.3**	**6.8**	**2.9**	**0.4**	**0.3**	**NA**
French above Diversion #48 (FRAB)	0.66	**8.2**	**8.4**	**3.1**	**1.7**	**1.4**	**5**
French Below Glide (FRBG)	0.36	**2**	**2.9**	**2.1**	**1**	**0.6**	**3**
French Above Wolford (FRAW)	0.18	**8.4**	**8.3**	**2.3**	**1.2**	**0.4**	**3.5**
French above Mouth 2 (FRAM2)	0.06	**10.8**	**9.8**	**NM**	**NM**	**NM**	**NM**
French above Mouth (FRAM)	0.02	**12.7**	**13.1**	**3.4**	**1.4**	**0.3**	**3.5**
Scott River above French (SCAF)		**36.3**	**32.1**	**12.8**	**6.6**	**2.2**	**11.5**
Scott River below French (SCBF)		**50.7**	**47.5**	**17**	**10.3**	**4.3**	**17.2**

NM = No measurement **NA = Not available**

Table 2 – In stream flow (cfs) measured above and below Diversion #48

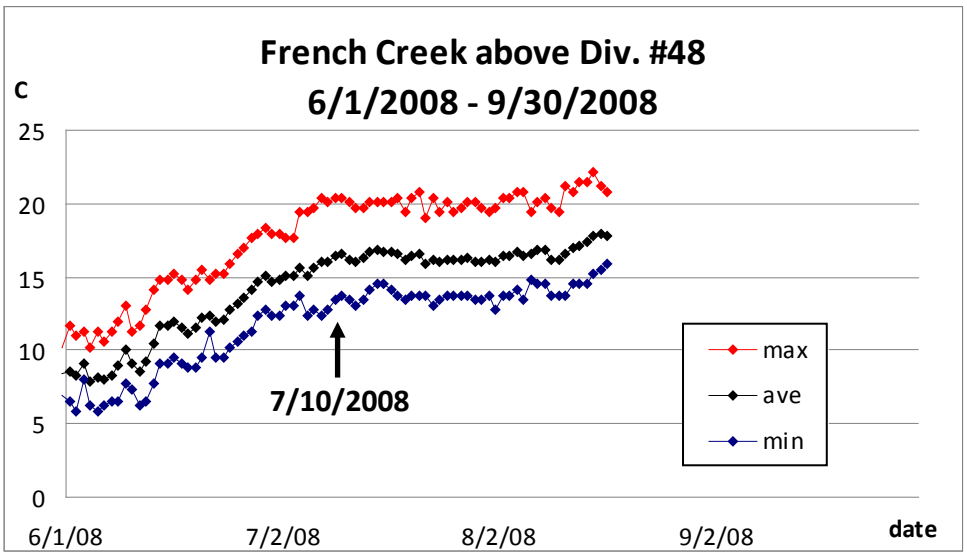


Map 1 – Flow locations monitored in Lower French Creek and Scott River – 2008

The discharge data shows an increase of 0.2 cfs above Div. #48 on July 11th in comparison to July 9th. The first flow transect shows an increase of 0.9 cfs over the period of these two days – attributable to the 0.2 cfs increase plus the 0.7 cfs increase from the forbearance of the instream water right. This gain in instream flow is not observed at downstream locations until the last transect in French Creek above the confluence with the Scott River (FRAM). A 0.4 cfs increase is observed at this location. The instream flow of the Scott River above and below the confluence of French Creek was also measured during the monitoring effort. A decrease of 4.2 cfs was observed at the location above the confluence of French Creek from July 9th to July 11th (before and after forbearance). In the same time period a decrease of 3.2 cfs was observed at the location below the confluence of French Creek. The 1 cfs increase in the discharge difference in the Scott River below and above French Creek is potentially partially attributable to the 0.7 cfs increase in French Creek flows due to the forbearance agreement.

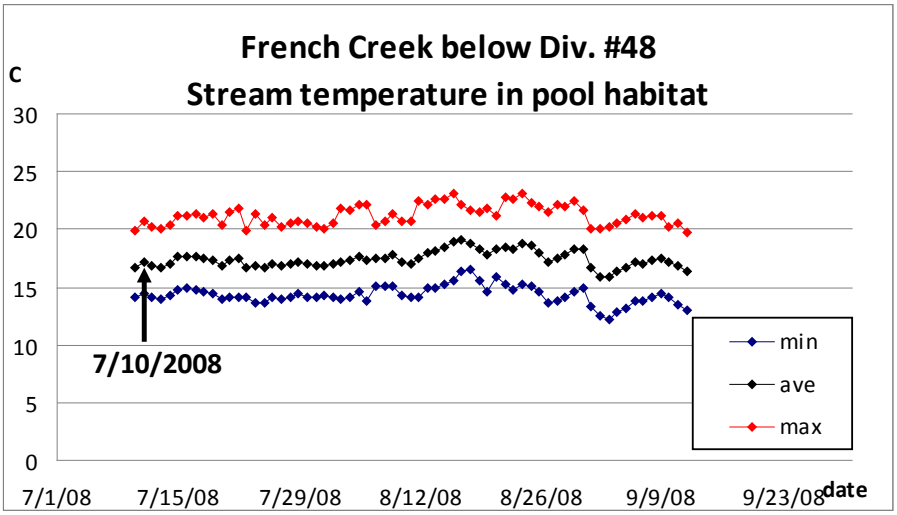
Water Temperature:

Continuous temperature monitoring was performed in one location above and two locations below the point of diversion for Div. #48 in Lower French Creek. A data logger was deployed above the point of diversion in a riffle habitat in May 2008 (Graph 4). This upstream logger failed on 8/18/2008 and no temperature data for this location is available after this date. Loggers were placed in a pool habitat (Graph 5) and a riffle/shallow glide habitat (Graph 6) downstream of the point of diversion on July 9th, 2008. These loggers were removed on September 11th, 2008. Upon evaluation, the removal of the loggers in mid-September was unnecessarily premature and temperature monitoring devices should be left in the stream until the end of the base flow period in future monitoring efforts.



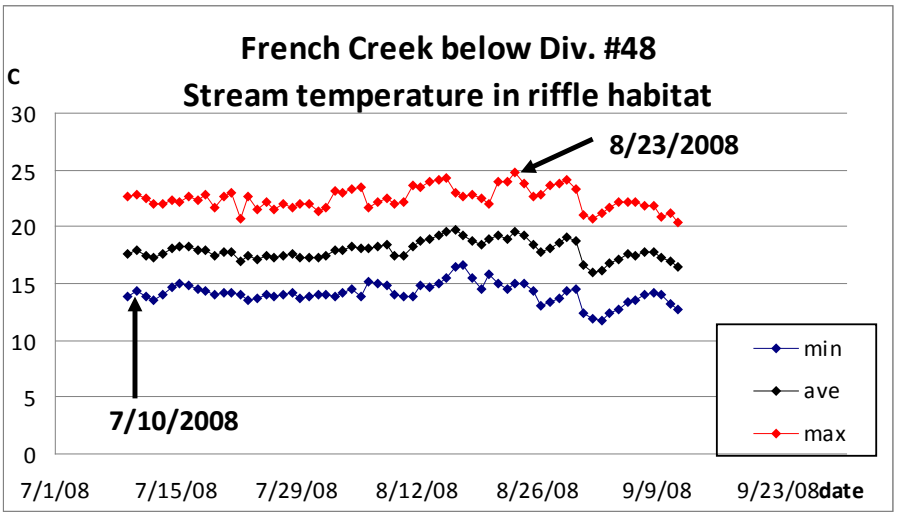
Graph 4 – French Creek above Div. #48 – riffle habitat. Device failed on 8/18/2008.

French Creek approached peak water temperatures associated with low flow through the month of June (Graph 4). The lease of 0.7 cfs of water at Div. #48 occurred at the beginning of the period of peak water temperatures.



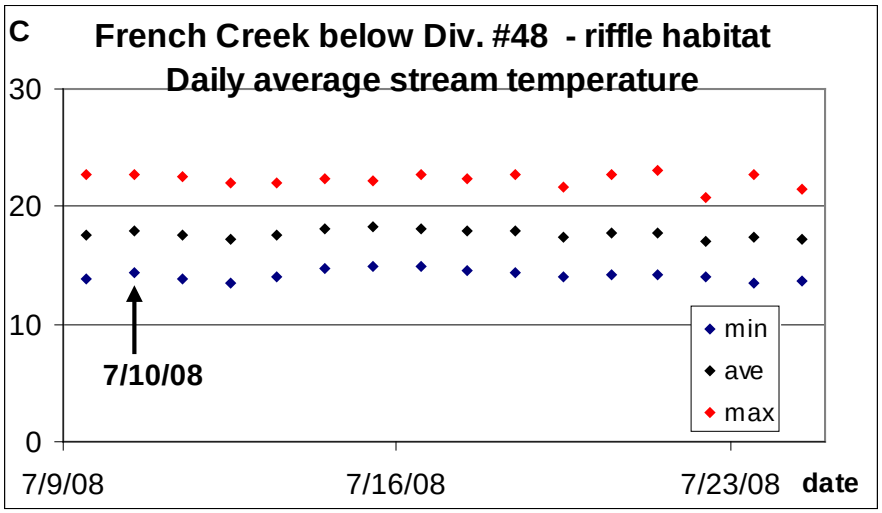
Graph 5 – French Creek below Div. #48 – pool habitat. Maximum MWAT = 18.5°, maximum MWMT = 22.4°. Maximum periodic temperature observed is 23.1° on 8/23/2008 at 16:30.

Water temperature in the pool habitat downstream of Div. #48 was mostly within the 3° C - 20° C (37 – 68° F) range that is "appropriate" for juvenile coho salmon (Hardy and Addley, 2001). The water temperature exceeded the 20° C threshold for several hours during the afternoon of most days in late July and August but juvenile salmon were observed rearing in the monitored pool and adjacent habitats.



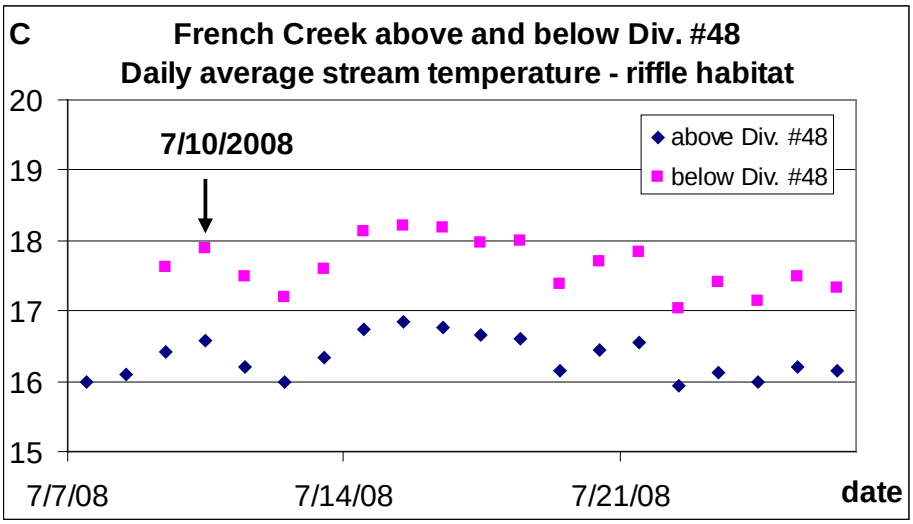
Graph 6 - French Creek below Div. #48 – riffle habitat. Maximum MWAT = 19.2°, maximum MWMT = 23.7°. Maximum periodic temperature observed is 24.8° on 8/23/2008 at 17:30

The maximum water temperatures recorded in the riffle were higher than those recorded in the pool. It is hypothesized that the riffle's wide shallow water and large surface area exposed to direct solar radiation causes increased peak water temperatures.



.Graph 7 – Daily average, minimum and maximum in the riffle habitat below Div. #48

Inspection of the water temperature in the riffle below Div. #48 in the immediate period before and after the lease shows no increase in stream temperature at this location (Graph 7). A minor decrease in water temperature with a slight decrease in daily fluctuation (e.g., difference in min and max temperature) is observed but it is difficult to attribute this change in temperature regime to the project or environmental conditions.

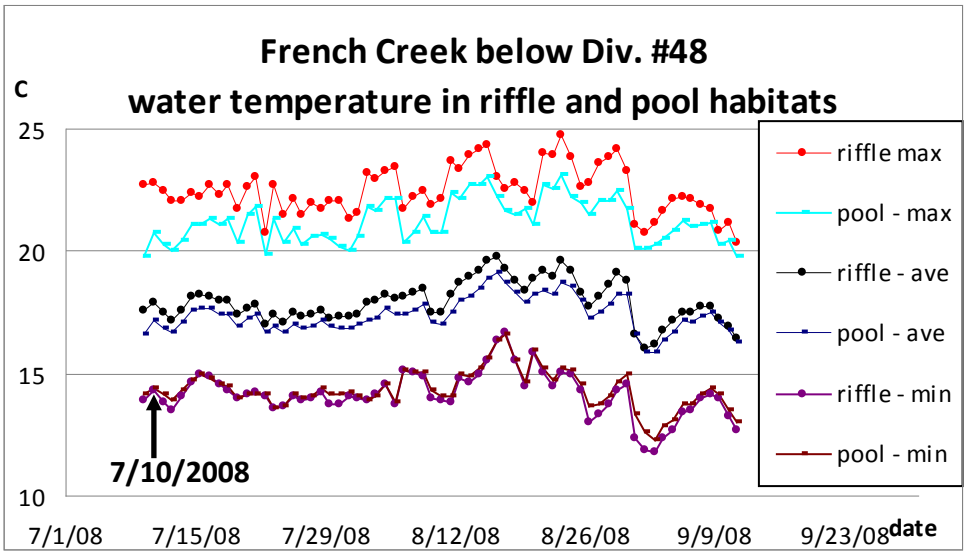


Graph 8 – Water temperatures in riffle habitat above and below Div. #48

The slight decrease in the average water temperatures below Div. #48 (less than 0.5° C) was observed in the riffle habitat above the point of diversion (Graph 8). It is hypothesized that the majority of changes in the thermal regime around the time of the transaction are attributable to changes in the environmental condition and the effect of the

additional instream flow had a negligible effect on the downstream water temperature regime.

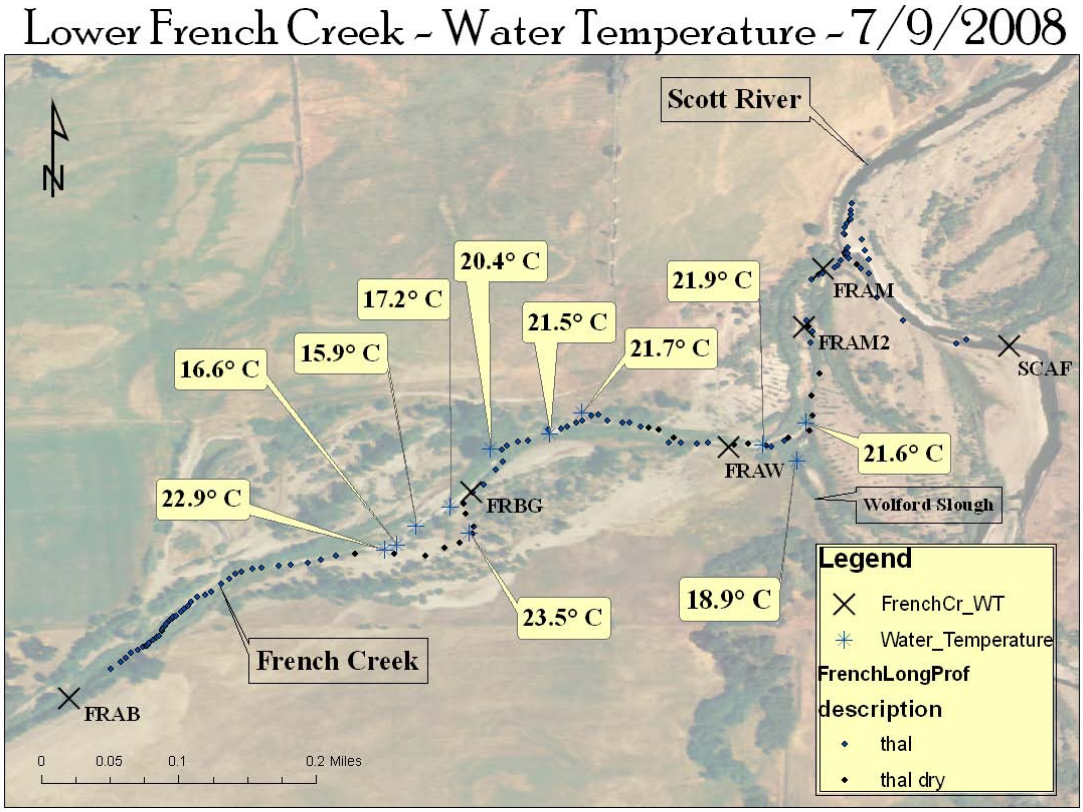
Further temperature documentation and analysis were performed in the reach downstream of Div. #48 to demonstrate the availability of habitats with suitable water quality and further understand the hydrology and complexity of the alluvial reach that was affected by the Water Trust's activities.



Graph 8 – Comparison of temperatures in pool and riffle habitat below Div #48 -

A comparison of the temperature regimes for the three continuous temperature monitoring locations shows a slight increase in temperature from the above Div. #48 site to the below pool site and a further increase in stream temperature at the downstream riffle/shallow glide habitat (Graph 8). A significant amount of the instream discharge was observed to be lost to the fine substrate of the streambed in the riffle habitat and reemerge in downstream locations. These observations led to the performance of periodic temperature surveys in the lower French reach to document local water temperatures in different habitats (Map 2).

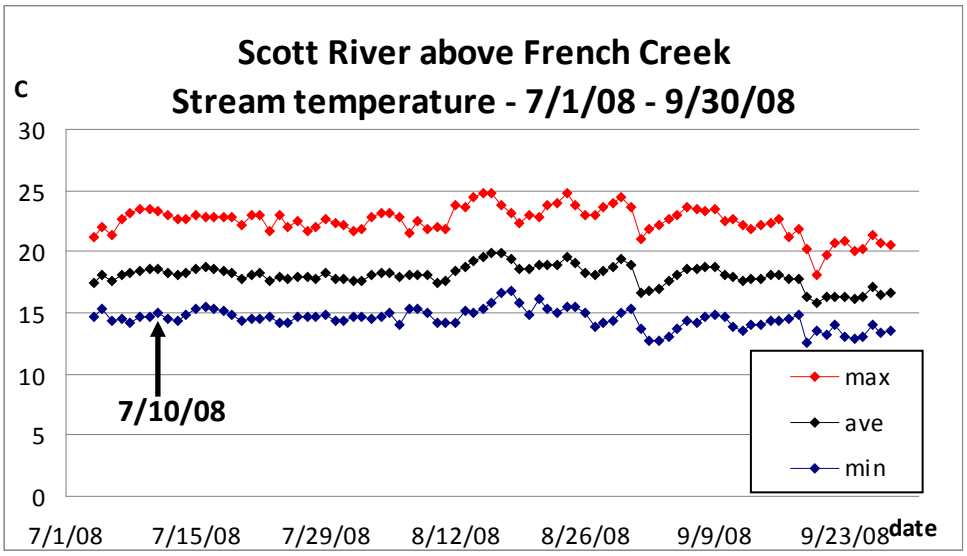
Picture 3 – Technician recording periodic temperature in a riffle in lower French Creek.



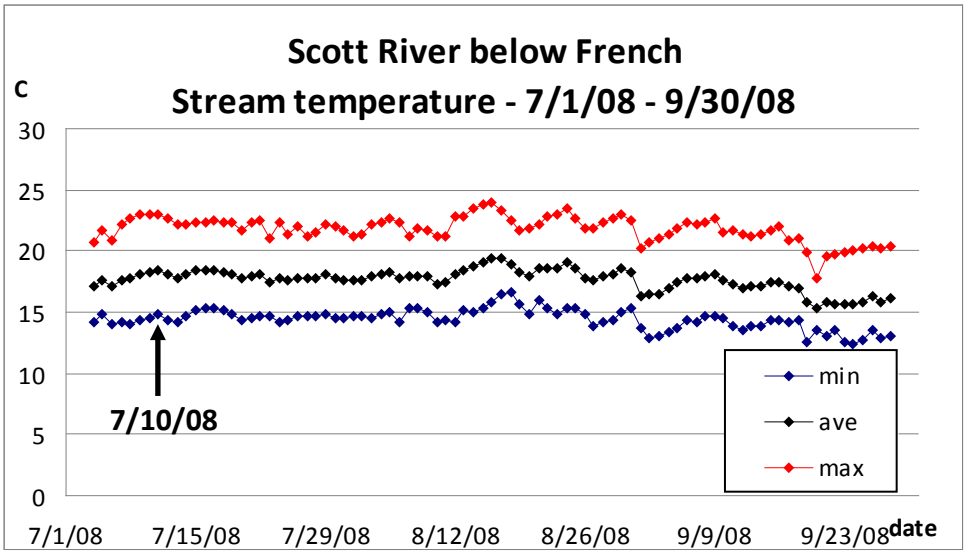
Map 2 – Periodic local water temperatures in Lower French Cr. on July 9th, 2008

Periodic surveys of select habitats were performed in lower French Creek before and after the transaction using a hand held temperature meter. Surveys were performed rapidly during the hottest period of the day (approx. 2:30pm – 4:30 pm) starting at the upstream end of the reach. These surveys showed significantly different temperatures in the different habitats of the reach. Several significantly cooler water temperatures (15.9° - 17.7° C) were observed in pools in a side channel adjacent to the monitored riffle (23.5° C). Water temperatures downstream from the riffle and side channel reach were all cooler (20.4° - 21.9° C) than the temperature recorded upstream of the glide (22.9°). If solar heating was the only process affecting water temperature one would expect a slight increase in recorded temperature as the survey effort moves downstream. It is hypothesized that a medley of groundwater – surface water interactions in this alluvial reach and a variety of levels of exposure to solar radiation is affecting the local water temperatures.

These periodic observations documented that the riffle in which continuous water temperature was monitored had the highest afternoon water temperature (23.5° C) observed throughout the reach. Exclusively monitoring the stream temperature in the first riffle below the project location would document the warmest waters and would not capture the presence of cooler temperature regimes in the deeper habitats occupied by target fish downstream.



Graph 9 – Scott River above French Creek - Maximum MWAT = 19.3°, maximum MWMT = 24.1°. Maximum periodic temperature observed is 24.8° on 8/15/2008 at 15:50.

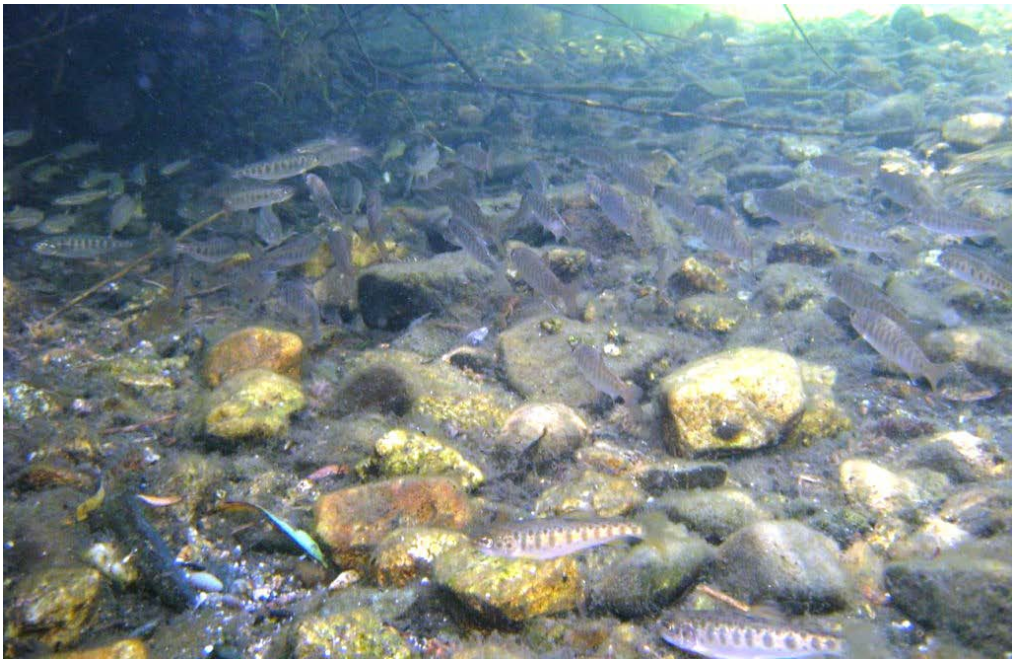


Graph 10 – Scott River below French Creek - Maximum MWAT = 18.9°, maximum MWMT = 23.3°. Maximum periodic temperature observed is 23.9° on 8/15/2008 at 16:30.

Water temperatures in riffles of the Scott River above and below the confluence with French Creek were recorded during the period of the Water Trust transaction (Graph 9 & 10). This data shows a decrease in the ambient water temperature of the Scott River downstream of French Creek in comparison to the temperature upstream of French Creek. No noticeable effect on water temperature is observed in the Scott River below French Creek after the leasing of 0.7 cfs of water on July 11th.

Fish surveys:

Direct observation surveys were performed in lower French Creek above and below the point of diversion for Div. #48 before and after the forbearance of the water. These surveys documented juvenile coho and Chinook salmon and rainbow trout throughout the reach of lower French. Two pools directly below the point of diversion had significant amounts of rearing salmon and trout utilizing deep water and water with terrestrial vegetation cover. Other species indicative of a diverse functional aquatic ecosystem including the western pond turtle (*Clemmys marmorata* - California Department of Fish and Game Species of Special Concern) and American beaver (*Castor canadensis*) were observed in the surveyed reach.



Picture 4 – juvenile coho and trout using instream cover in lower French Creek

Juvenile coho were often found in pool habitats and deeper glide habitats that offered cooler local water temperatures combined with over hanging and/or instream fish cover elements. Coho and Chinook salmon were observed in a pool in a sidechannel offering extensive cover from willow and water temperatures of 18.8° C. This contrasts with an adjacent pool of equivalent size that lacked the extensive cover and had water temperatures of 23.0° C in which only rainbow trout were observed. These two waters mixed at a pool with willow cover and large numbers of coho salmon with temperatures of 21.3° C observed at the pool's tail out. Coho and Chinook salmon were found in multiple habitats below these locations and were usually associated with small pockets of percolating water that was considerably cooler than the well mixed waters of the stream's riffles. A pool directly above the mouth of French Creek had a temperature of 16.4° C on its bottom and cold water and juvenile salmon were observed in the Scott River at the confluence of French Creek. Juvenile salmon and cooler water was documented in a scour hole in the Scott River below the confluence with French Creek. A similar scour

hole in the Scott River above French Creek had no observable cold water input and no coho or Chinook salmon.

Several beaver dams were observed in the lower portion of this reach of French Creek. These dams significantly impounded the water creating large volumes of low velocity water. The affect these dams have on stream temperature and groundwater recharge requires further study.

Diversion #33 – Miners Creek (RM = 1.9)

Picture 5 – Pool below diversion #33 – Miners Creek

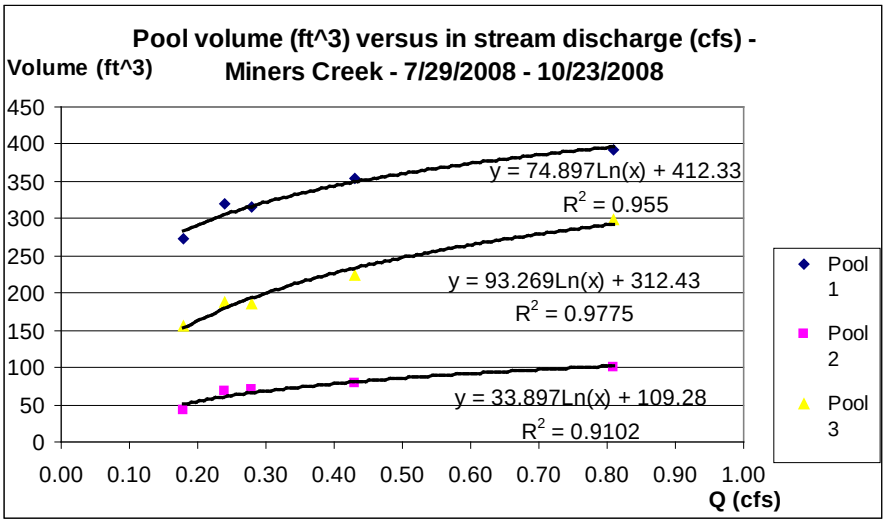
In stream flow and pool volume

Pool volume was measured in three pools in Miners Creek downstream of Div. #33 (Table 3). Stream discharge was measured at the same time as the pool volumes were monitored at a bedrock defined transect with laminar flow directly above the first measured pool. The measured stream discharge did not exceed 1.0 cfs in the period of monitoring effort (7/29 – 10/23/2008) and the accuracy and precision of the current meter at this low flow regime is debatable. The Pygmy current meter is rated for operation in flows of 0.1 - 4.9 ft/s and all velocity measurements outside the extreme margin exceeded the 0.1 ft/s threshold. Potentially more importantly, it is almost impossible to divide a defined transect of such low flows into enough cells so that each individual cell's discharge is only 5% of the entire discharge ($q/Q < .05$). This criterion was not met with these discharge measurements performed in Miners Creek.

Pre and Post Monitoring of Pool Volumes on Miners Creek					
	7/29/2008	8/1/2008	8/16/2008	8/28/2008	10/23/2008
Pool 1 (ft^3)	272	316	319	353	392
Pool 2 (ft^3)	43	70	69	78	101
Pool 3 (ft^3)	155	186	188	224	299
Flow (cfs)	0.2	0.3	0.2	0.4	0.8

Table 3 – Table showing pool volumes and in stream discharge on Miners Creek.

An increase in pool volume and in stream flow was observed after the transactions of 7/29/2008 and 8/21/2008. All pools gained volume between the initial pre treatment measurement of 7/29/2008 and the post treatment measurement performed on 8/28/2008. An increase over initial volume of 30% was observed for Pool 1, an increase of 81% was observed for Pool 2, and an increase of 45% was observed for Pool 3. The combined volume of the three pools was increased to 656 cubic feet on 8/28/2008 from 470 cubic feet on 7/29/2008 – an increase of 40%. The final pool volume and flow measurement was performed on 10/23/2008 - showing a combined increase of approximately 70% of the initial pre-treatment pool volume. Discharge of Miners Creek is still approximately 1 cfs at this time.

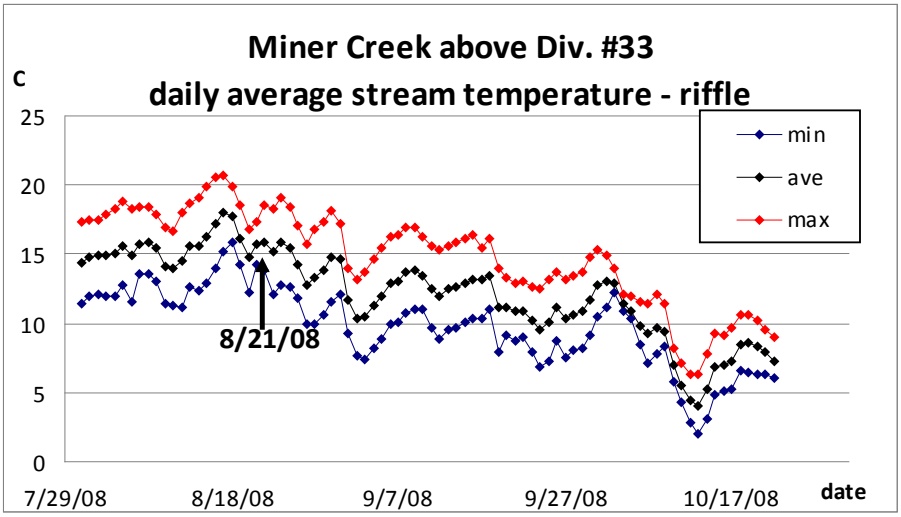


Graph 11 – Pool volume (cubic feet) versus in stream discharge (cfs) for three pools in Miners Creek below Div. #33.

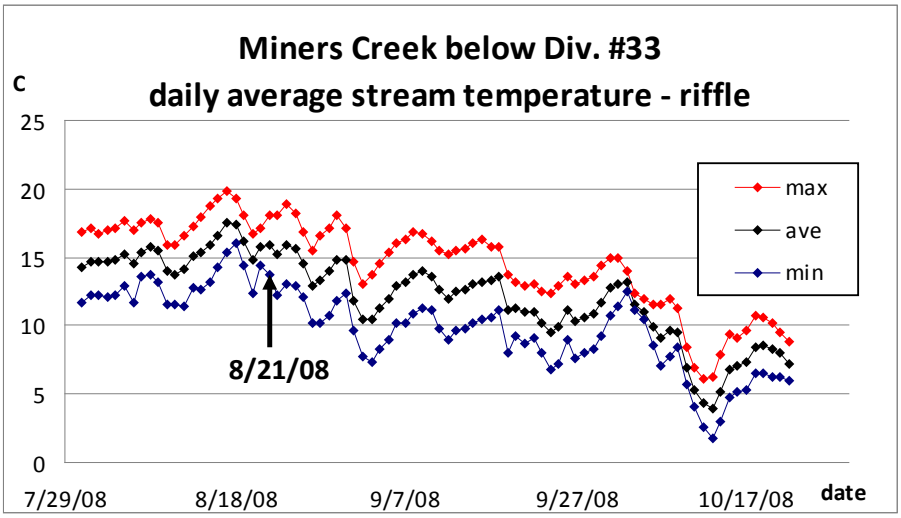
The measured pool volumes were graphed in relation to the instream discharge measured at time of pool volume measurement (Graph 11). Log equations were generated from the collected data. It is hypothesized that this data could be used to evaluate the affect on pool volume from an increase in instream discharge.

Stream Temperature

Stream temperature was monitored in riffle habitats above and below Div. #33 from 7/29/2008 – 10/24/2008 (Graph 12 & 13). The temperature monitoring devices were not placed in stream for the 24 hour period before the first transaction of .2 cfs on 7/29/2008 but were in place during the transfer of an additional .3 cfs to Miners Creek on 8/21/2008.



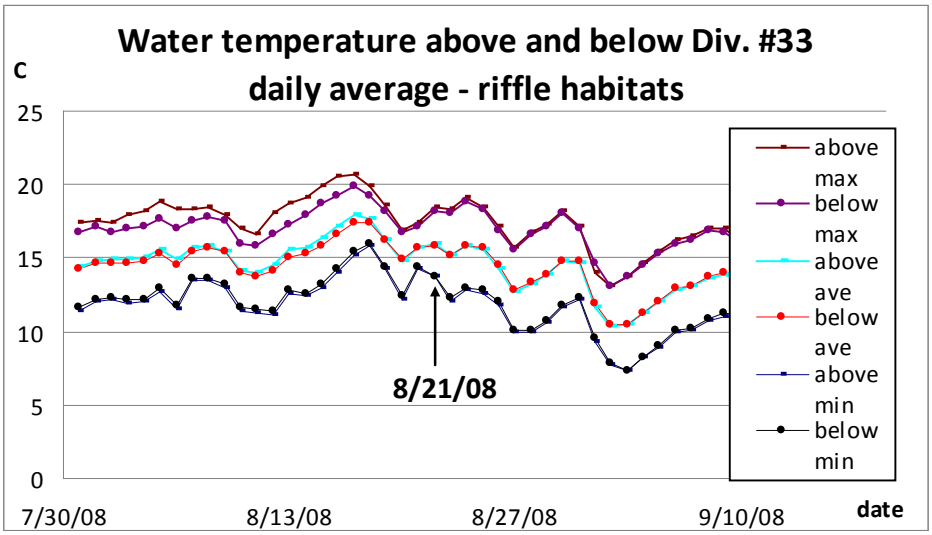
Graph 12 – Miners Creek above Div. #33 - Maximum MWAT = 16.6°, maximum MWMT = 19.6°. Max periodic temperature observed is 20.7° on 8/16/2008 at 17:24.



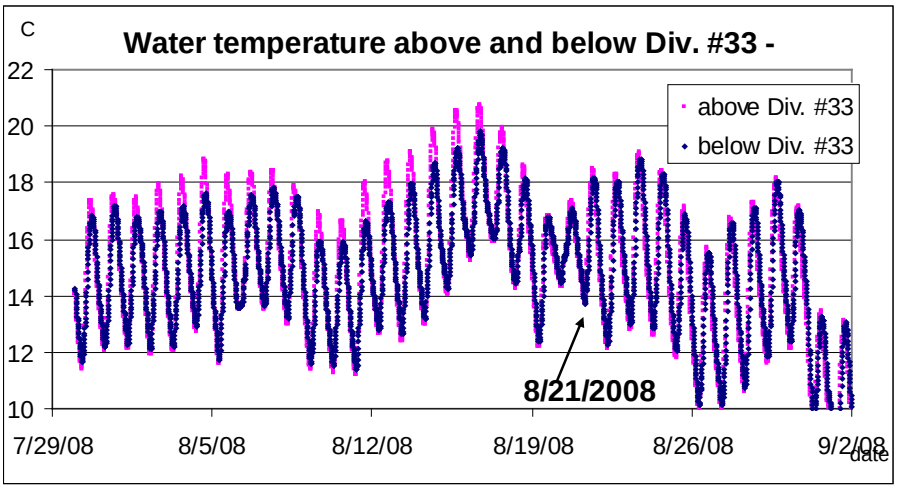
Graph 13 – Miners Cr. below Div. #33 - Maximum MWAT = 16.3°, maximum MWMT = 18.6°. Max periodic temperature observed is 19.8° on 8/16/2008 at 17:40.

The temperatures recorded above and below Div. #33 were both within the range of "appropriate" temperatures for juvenile coho salmon (Hardy and Addle. 2001) and steelhead trout. The periodic temperature never exceeds 20° C below Div. #33 and exceeds 20° C for only a few hours for two days at the upper location. No significant observable temperature affect was recorded during the period of the second transaction

on 8/21/2008 that is not accountable by a change in the air temperature regime (Graph 13).



Graph 14 – Stream temperature above and below Div. #33 – Miners Creek



Graph 15 – Continuous stream temperature above and below Div. #33 – Miners Creek

Surprisingly, maximum water temperatures were warmer at the up stream site (above Div. #33) than those recorded at the down stream site (Graphs 14 & 15). These two sites are located approximately 2,000 feet from each other and the entirety of this distance is well vegetated with riparian trees and conifers. The two locations had the same date and time of peak instantaneous water temperature at approximately 5:30 pm on 8/16/2008 with the below Div. #33 peak being 0.9 °C cooler than that recorded above Div. #33. Potential explanation for this unexpected decrease in temperature moving downstream is the influence of ground water recharge from the adjacent lands and/or unlined ditch.

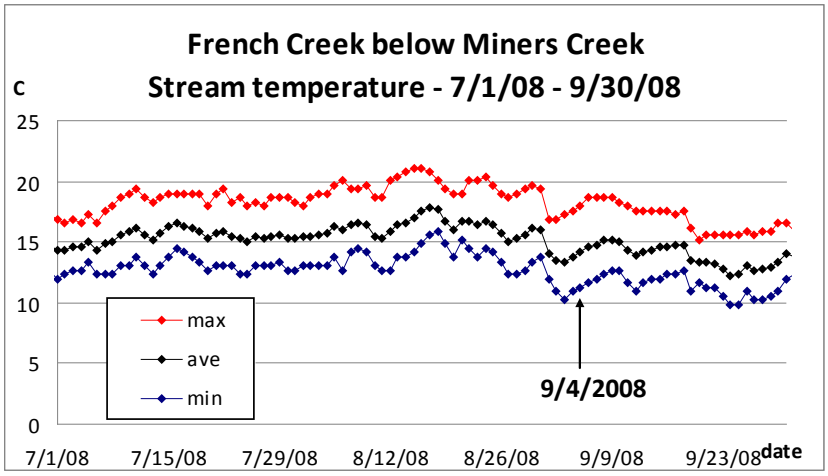
Fish surveys:

No fish surveys were performed per the requirement of the landowners

Diversion #36 – Miners Cr (RM = 0.5)

No monitoring was performed on this transaction.

A temperature device was operating in French Creek below the confluence with Miners Creek (Graph 16). Suitable temperatures for rearing salmonids were documented in this reach of French Creek that was affected by the water leased in Miners Creek.



Graph 16 – French Creek below Miners Creek - Maximum MWAT = 17.1°, maximum MWMT = 20.6°. Max periodic temperature observed is 21.1° on 8/14/2008 at 15:32.

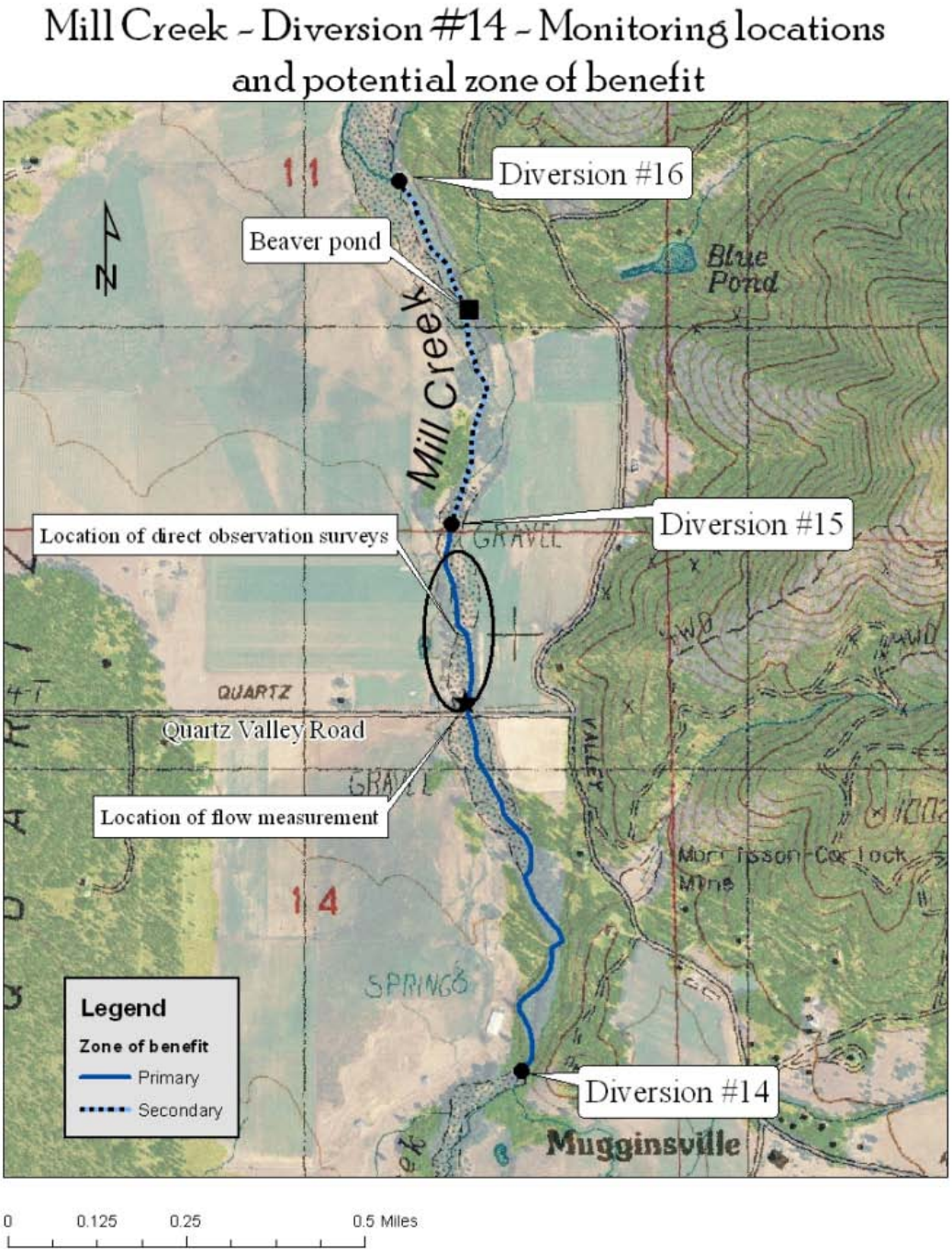
Shackleford Creek Watershed
Diversion #14 – Mill Cr (Quartz Valley) (RM = 4.6)

Picture 6 – Pool with fish cover from root mass and overhanging riparian canopy

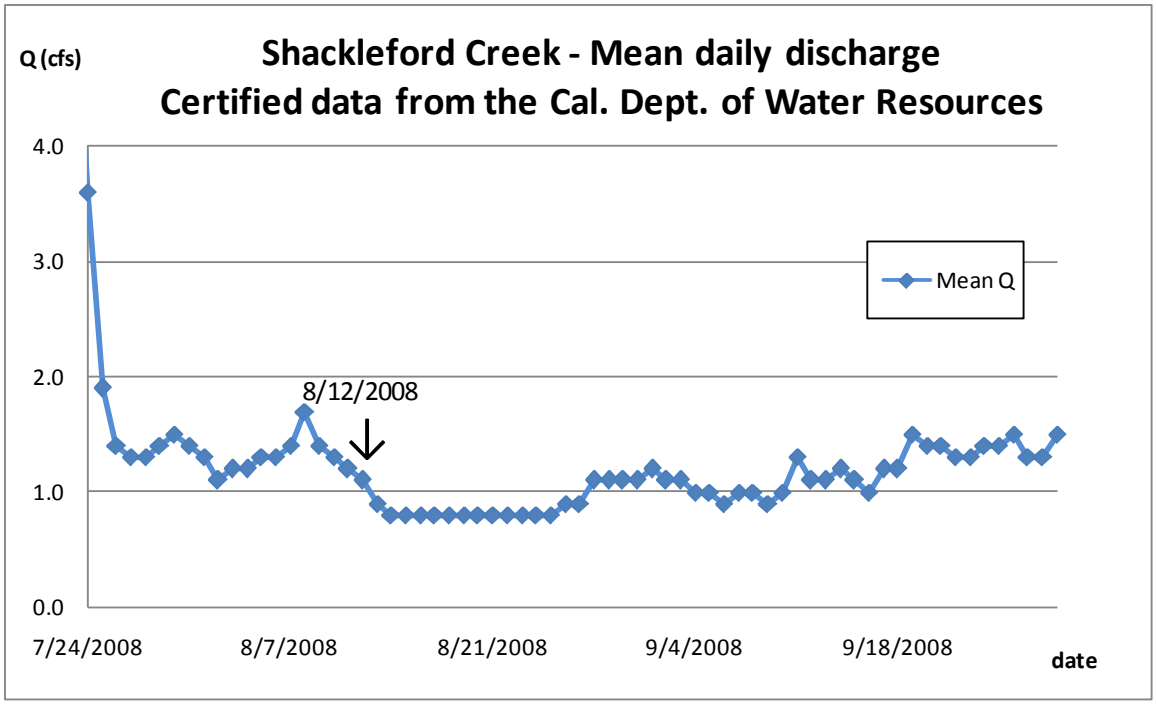
Due to the nature of the transaction, adequate time to monitor the parameters of Mill Creek before the leased water was returned to instream flows was not available. A field survey was performed on Mill Creek on August 14th, 2008 to document the presence of juvenile salmonids and determine the instream flow directly after the forbearance of 0.7 cfs of water. The instream flow was measured at a riffle crest of a pool just downstream of the Quartz Valley Road Bridge below the point of diversion (Map 3). A flow of 5.6 cfs was recorded in the early afternoon of August 14th. It was noted that this was a significant volume of water in comparison to many locations that were being monitored for discharge for this project in early August (e.g. Lower French Creek and Patterson Creek). This measured flow in Mill Creek at the Quartz Valley Bridge was also significantly greater than the continuously monitored flow in Shackleford Creek below the downstream Quartz Valley Bridge. Mean daily discharge was 0.8 cfs at the location of the staff gage on 8/14/2008 (certified data supplied by John Clements - Senior Engineer Cal. Dept. of Water Resources, Northern District). There are a significant amount of diversions between the leased water in Mill Creek and the DWR flow gage in Shackleford, limiting the use of the DWR data to documenting that Shackleford was at or near base flow during the period that water was leased from Mill Creek

Direct observation surveys were performed in several pool and deep glide habitats downstream of the Quartz Valley Road Bridge. The reach was characterized by a mature stand of alder on both sides of the stream and almost complete canopy cover of the water. Excellent instream habitat and multiple types of fish cover were observed through this reach. Coho salmon were observed in high densities utilizing the deeper low velocity

waters with habitat complexity from submerged root mass, undercut banks, coarse woody debris aggregates, instream terrestrial vegetation and aquatic vegetation.



Map 3 – Location of monitoring sites and potential zone of benefit in Mill Creek



Graph 16.1 – Mean daily discharge in lower Shackleford Creek – data courtesy of DWR

Picture 7 & 8 - Juvenile coho salmon and rainbow trout in Mill Creek below Diversion #14 (left) and direct observation survey in glide with aquatic vegetation and over stream alders (right)

Patterson Creek
Diversion #390 – above HWY3 (RM = 4.5)

Picture 9 – Patterson Creek below Diversion #390

A summer lease of water in Patterson Creek was pursued due to the presence of a high density of adult coho spawning in the winter of 2007-2008 and a large amount of rearing juvenile coho in summer. Previous habitat typing efforts and biological surveys demonstrated the presence of suitable stream and riparian habitat and the presence of juvenile coho during years of the strong cohort, but little was known about the flow and temperature regime of the reach above Highway 3. Patterson Creek is outside of the area water mastered by the California Department of Water Resources (DWR), so no information about water supply was available from this important source that helped direct the transactions of water in the French and Shackleford Watersheds during the 2007 and 2008 summer seasons. The monitoring activities of the Water Trust documented continuous water temperature and periodic flow in Patterson Creek in conjunction with pool volume and biological surveys to better understand the available water and water quality in this small tributary to the Scott River.

Diversion #390 is the highest diversion in the Patterson Creek watershed. The Water Trust leased the entire volume of water (1.0 cfs) being diverted at Diversion #390 on July 3rd, 2008. The landowner also instructed the Water Trust to shut down the two ditches below the upper ditch on the 3rd of July. The middle ditch was not currently diverting water but the lower ditch (above Highway 3) was diverting an additional 1.0 cfs from Patterson Creek. This ditch was shut down allowing for a total of 2.0 cfs to be returned to Patterson Creek above Highway 3 on July 3rd. The landowner was only compensated for the water returned to instream flows at the upper most point of diversion.

Patterson Creek was the first attempt by the Water Trust to lease and monitor summer flows in a tributary of the Scott River that is not water mastered by DWR. The Scott

River has three separate decrees: the French – Miners Creek decree, the Shackleford – Mill Creek decree and the Scott River decree. DWR water masters the French Creek and Shackleford Creek decrees but not the Scott River decree. The Scott River decree contains the adjudicated water rights in the main stem Scott River and all tributaries outside of the French and Shackleford Watersheds. DWR's Watermaster has extensive knowledge and experience with the water supply available in the watersheds that are mastered but no experience in the other locales. This led to a higher level of uncertainty regarding how much water was available in Patterson Creek during periods of base flow. Monitoring activities attempted to document available instream water quality and water supply and verify the volume of water being diverted before forbearance.

Due to the lack of prior knowledge regarding the amount of available water in Patterson Creek at base flow the water was allowed to enter Diversion #390's point of diversion and move through the fish screen box and then exit to the creek via the fish screen by pass. This allowed for the documentation of the "potential" water that the ditch user would be receiving throughout the transaction season by measuring the discharge of water entering the fish screen box. The decline in this "potential" amount of divertible water during the period of the lease agreement drove a staggered contract to the landowner in which they received varied compensation from 1.0 cfs at the beginning of the transaction to 0.5 cfs for the remainder.

Instream flow and pool volume

Four different habitat units were selected for pool volume measurements before and after the transaction of 1.0 cfs of water at Diversion #390 in Patterson Creek. A "Control Pool" was established above the point of diversion to document any change in pool volume that is due to a change in the environment (e.g. stream discharge) and not attributable to the actions of the Water Trust. Three habitats with observed juvenile coho were selected below the fish screen's bypass – a glide (Glide_1), a plunge pool (Pool_1) and a large pool with significant fish habitat elements (Pool_2). The transects and locations for depth measurements were established in each unit from July 1st – July 3rd before the return of water to Patterson Creek began. The discharge in Patterson Creek was measured on July 1st and July 2nd with values of 6.4 cfs and 6.6 cfs, respectively. The stream discharge was not measured on the 3rd due to time constraints and the belief that previous measurements established the pre treatment instream flow at 6.5 cfs. The pool volume measurements and instream discharge measurements were performed on the 4th of July to document environmental conditions directly after the return of the instream flow to Patterson Creek.

Picture 10 & 11 - Control pool (left) and Glide_1 (right) in Patterson Creek

Picture 12 & 13 - Pool_1 (left) and Pool_2 in Patterson Creek

Picture 14 - A representative transect in Pool_2 along which depths will be measured

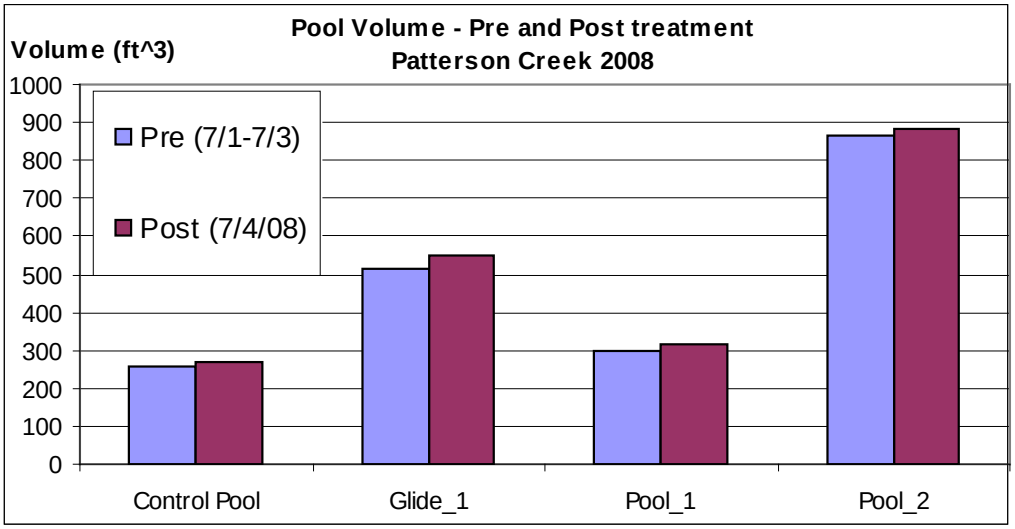
Patterson Creek - Diversion #390 - Pool volume (cubic feet) and stream discharge (cfs)

	7/1 -7/3/08	7/4/2008	7/14/2008	7/22/2008	8/1/2008	8/12/2008	9/9/2008	9/26/2008	10/23/2008
Control Pool	259	266	199	171	141	NM	101	77	113
Glide_1	514	552	379	316	284	NM	165	162	239
Pool_1	301	314	NM	NM	NM	NM	NM	0	25
Pool_2	865	881	NM	NM	NM	NM	NM	192	582
Patterson Cr. (Q)	**6.5**	**5.9**	**3.1**	**2.1**	**1.6**	**1.2**	**0.5**	**0.5**	**0.8**
Fish Screen Inlet (Q)	1.7	1.7	1.1	0.5	0.4	0.1	0	0	NM
Ditch	1.1	0	0	0	0	0	0	0	0

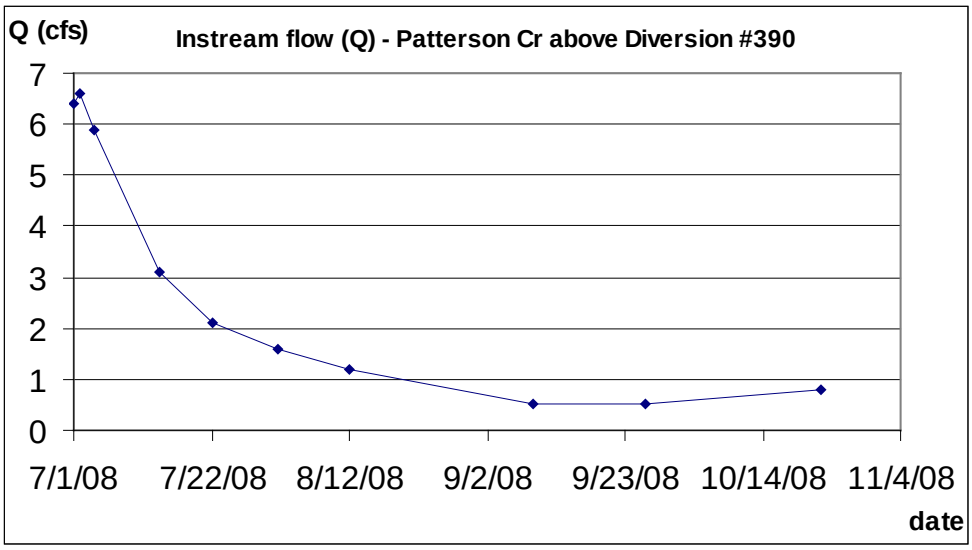
NM = Not measured

Table 4 – Pool volumes and stream discharge on Patterson Creek

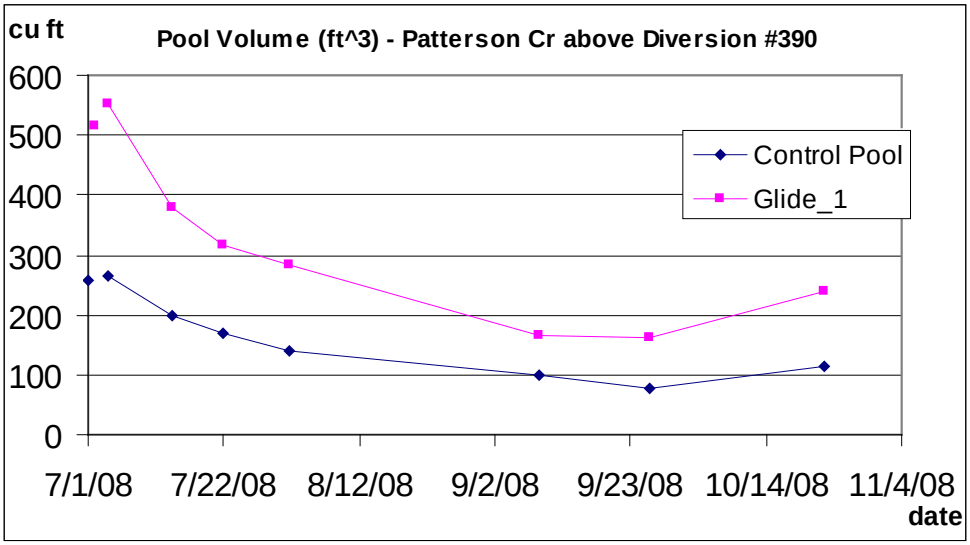
The habitat volumes of the Control Pool and Glide_1 unit were measured several times from July through late October (Table 4). The instream flow was measured during each of these exercises. The combined pool volume below Diversion #390 before the transaction was 1680 cu ft. This combined volume was increased by 67 cu ft to a total of 1747 cu ft on the 4th of July after 1.1 cfs of water was added to the instream flow. This post treatment total pool volume was 4% greater than the pre treatment total pool volume (Graph 17). Instream flow in Patterson Creek and pool volumes decreased significantly through July with a stream discharge of less than 2 cfs documented on August 1st. Instream flows continued to decline through September and flows less than 1 cfs were documented in September and late October (Graph 18). Documented pool volumes were at there lowest level on September 26th (Graph 19).



Graph 17 – Pool volume in all four habitat units before and after water is added.

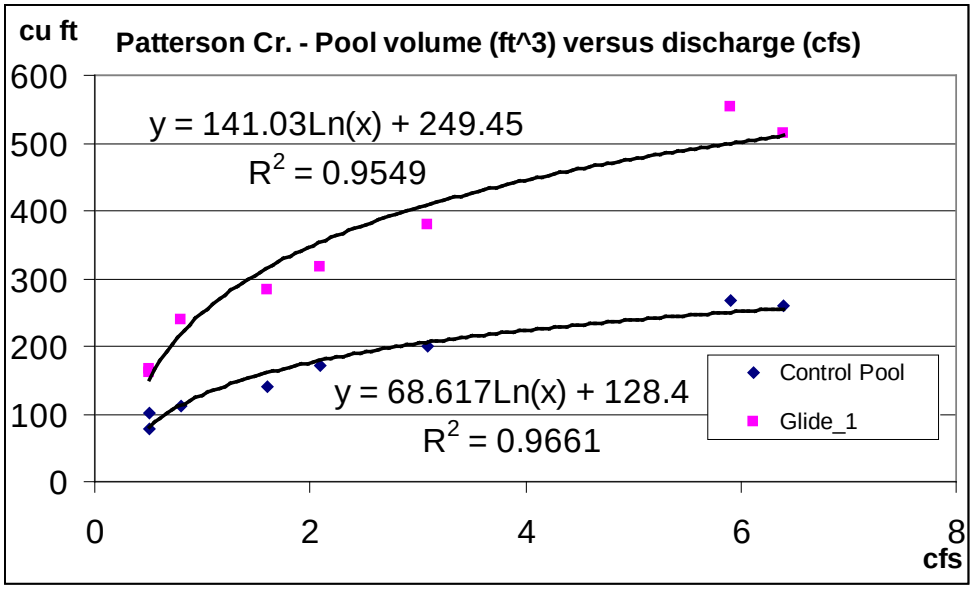


Graph 18 – Instream flow of Patterson Creek above Diversion #390

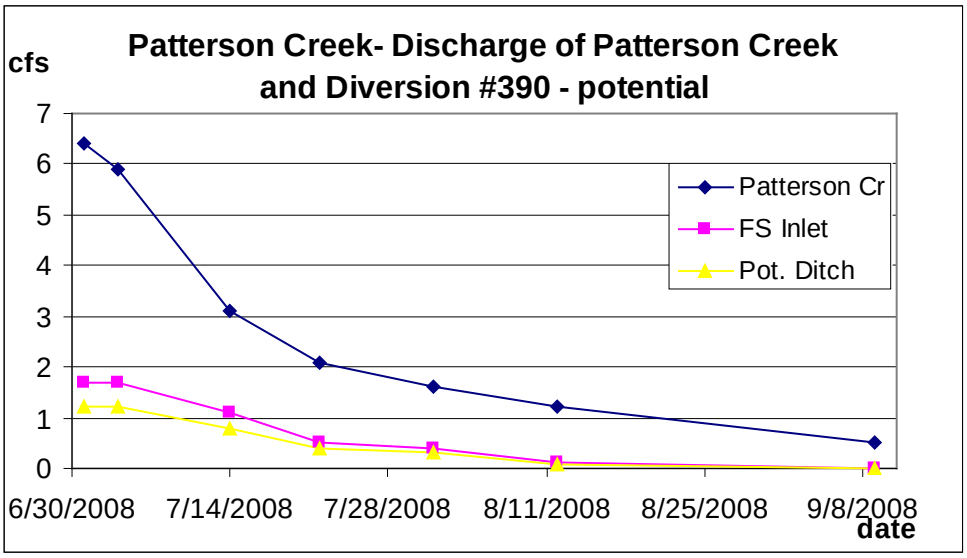


Graph 19 – Pool volumes in control pool and glide

The pool volumes of the Control Pool and Glide were graphed versus the measured discharge and a logarithmic equation was generated from the trend of the data set (Graph 20). This equation could be used to determine the potential pool volume at stream discharge levels that were not monitored. The "potential" diversion volume was also calculated using the measured ratio of discharge at the fish screen inlet and in the ditch before the lease was executed (Graph 21). This exercise was performed to determine the volume of water the ditch could potentially divert from the discharge measurements performed at the fish screen inlet.



Graph 20 – Control pool and glide volume versus instream discharge

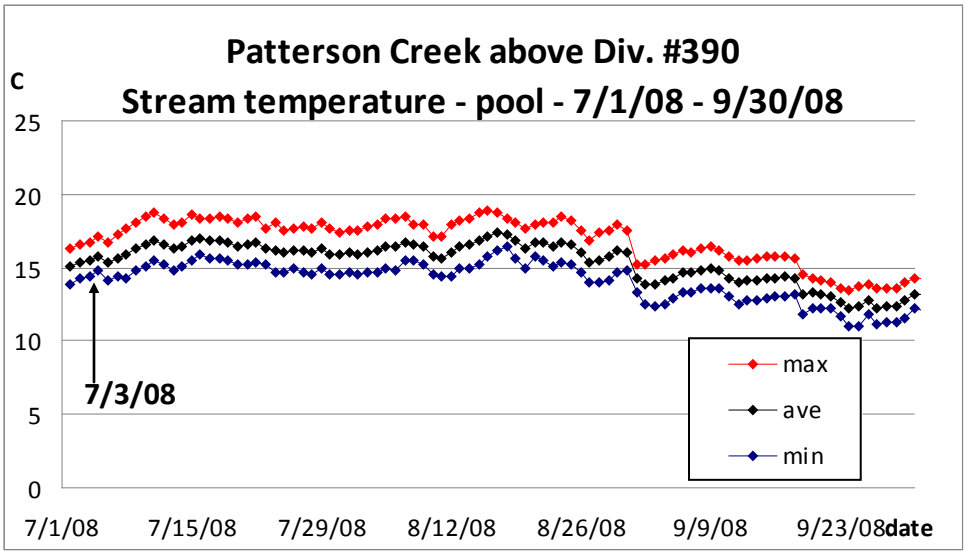


Graph 21 – Potential ditch calculation for Water Trust

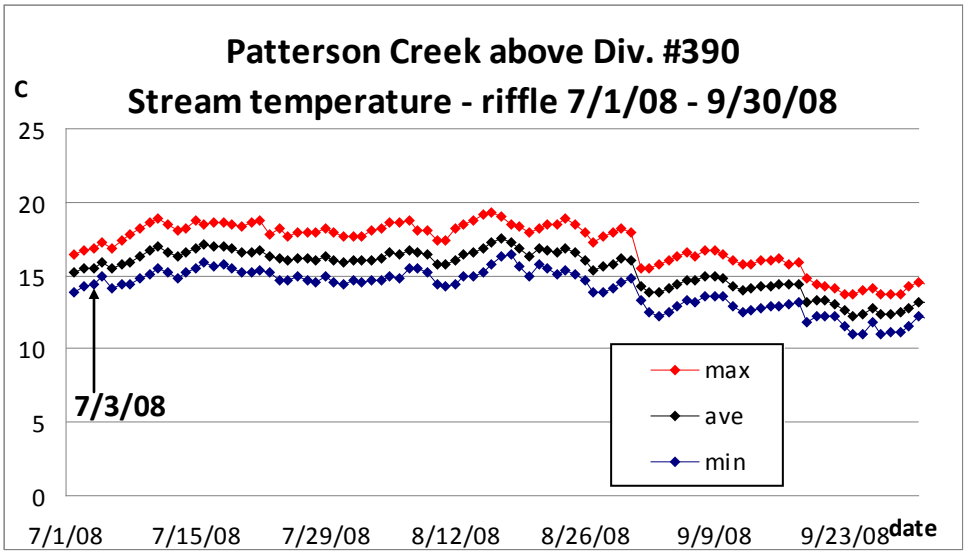
Water Temperature:

Picture 15 – The deployment of a water temperature logger in a pool occupied by coho salmon in Patterson Creek.

Water temperature was monitored in four locations in Patterson Creek around the point of diversion for #390. Temperature devices were placed in a pool and riffle habitat above and below the point of diversion on 6/30/2008. Water temperatures were continuously monitored until late October. All recorded water temperatures were below the 20° C threshold that is suitable for juvenile coho salmon (Hardy and Addley, 2001). It is hypothesized that the mature riparian canopy throughout the surveyed reach maintains suitable water temperature regimes for coho salmon even during periods of low instream flow (less than 1 cfs).

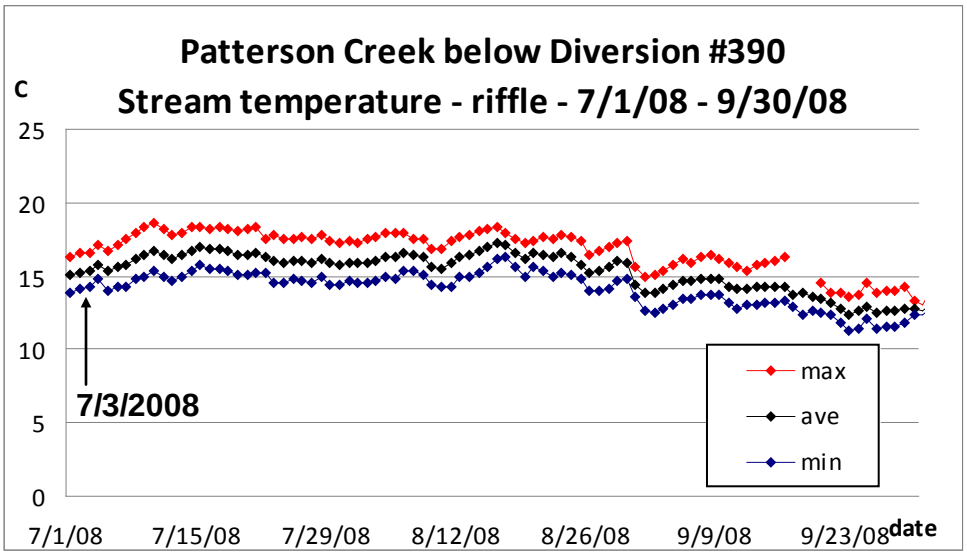


Graph 22 – Patterson Creek above Diversion #390– pool habitat - Maximum MWAT = 16.9°, maximum MWMT = 18.5°. Maximum periodic temperature observed is 18.9° on 8/15/2008 at 15:14.

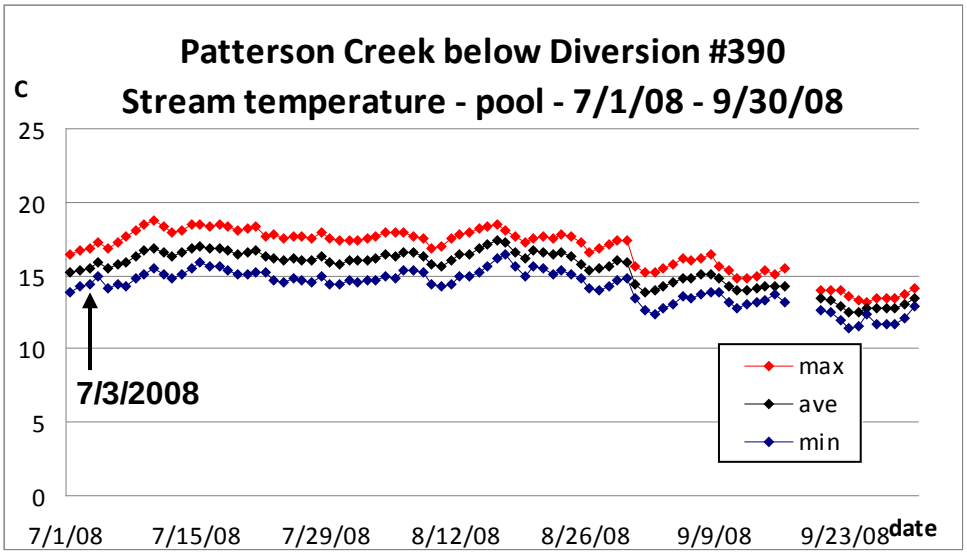


Graph 23 – Patterson Creek above Diversion #390– riffle habitat - Maximum MWAT = 17.0°, maximum MWMT = 18.8°. Maximum periodic temperature observed is 19.3° on 8/15/2008 at 15:14.

The water temperature regimes documented in the riffle and pool habitat above the point of diversion were almost identical (Graph 22 and 23). A slightly higher MWAT, MWMT and maximum periodic temperature was observed in the riffle habitat in comparison to the values for these parameters observed in the pool habitat. The difference is almost insignificant and both locations offered a "suitable" temperature regime for juvenile coho with temperatures not exceeding 20° C at any time. Direct observation surveys documented coho salmon and rainbow trout utilizing the monitored pool allowing for the documentation of the temperature regime for a habitat with rearing coho.



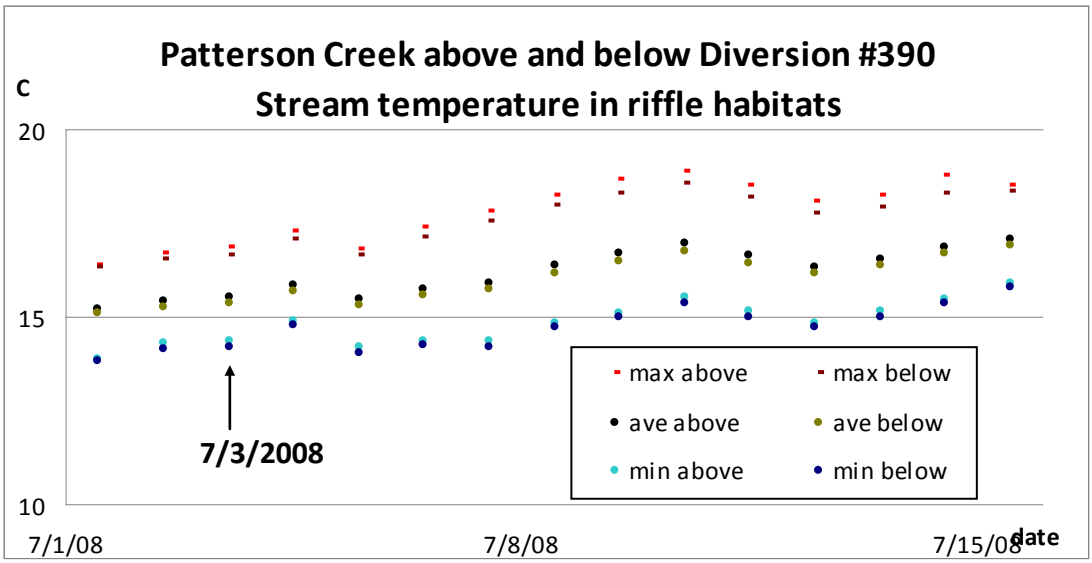
Graph 24 – Patterson Creek below Div. #390– riffle - Maximum MWAT = 16.7°, maximum MWMT = 18.3°. Maximum periodic temperature observed is 18.6° on 7/10/2008 at 14:43.



Graph 25 – Patterson Creek below Div. #390 – pool - Maximum MWAT = 16.9°, maximum MWMT = 18.4°. Maximum periodic temperature observed is 18.7° on 7/10/2008 at 14:42.

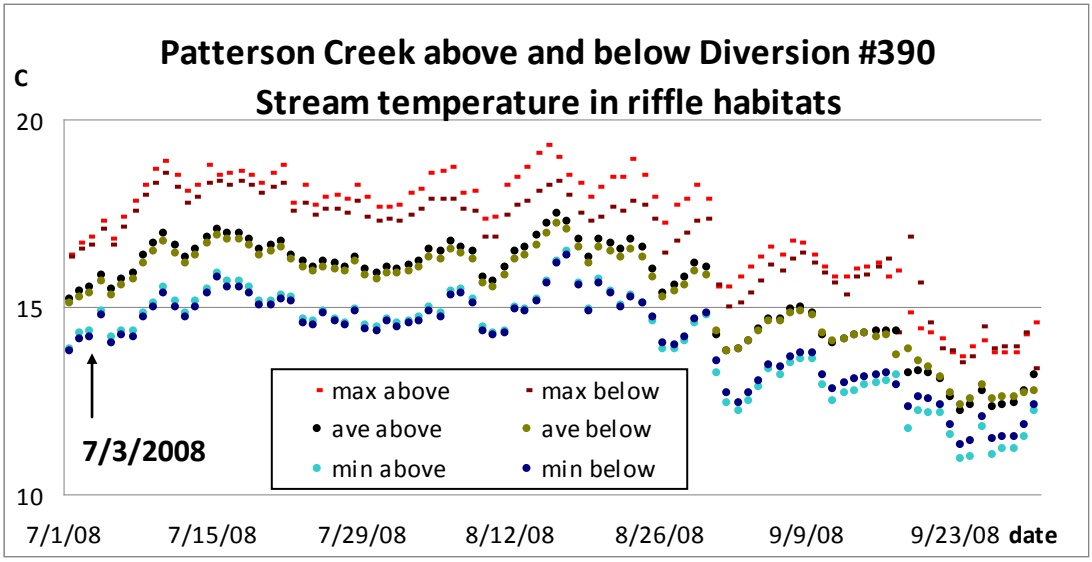
A pool and riffle habitat was continuously monitored for water temperature below the point of diversion and fish screen bypass for the period of transaction (Graph 24 & 25). The water temperature regime was almost identical in these two habitats. Juvenile coho and rainbow trout were observed in the pool habitat in large amounts during direct observation surveys.

Picture 15 & 16 – direct observation survey of temperature monitoring pool below Upper Youngs point of diversion (left) and juvenile coho and trout rearing in pool (right).



Graph 26 – Water Temperature above and below Diversion #390 before and after transaction– riffle habitats – 7/1/2008 – 7/15/2008.

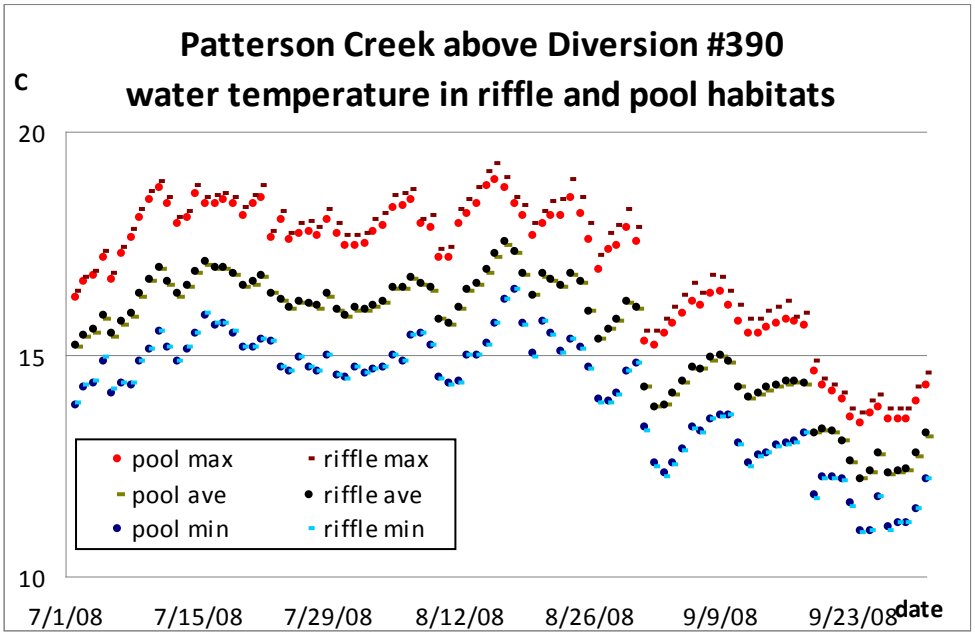
Graph 26 shows the water temperature in riffle habitats above and below Diversion #390. On the 3rd of July, 1.0 cfs of water was returned to the instream flows of Patterson Creek. This additional water had either no affect on the water temperature below the point of diversion or potentially cooled the waters slightly in comparison to the upstream control. A negative affect on the temperature regime (e.g. warmer water at the downstream riffle) was not observed.



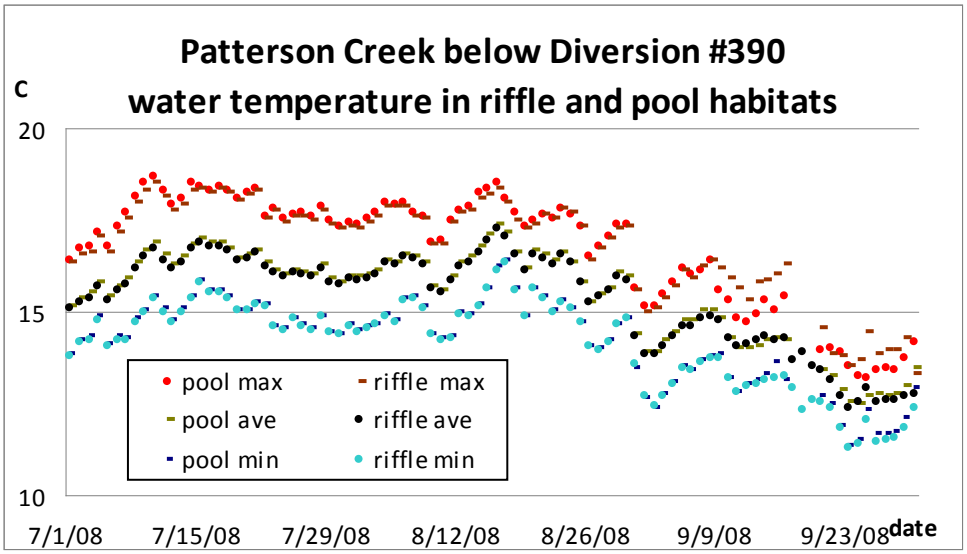
Graph 27 – Water temperature in Patterson Creek above and below Diversion #390 – riffle habitat – whole season.

The water temperature regimes recorded in the riffle habitats above and below the point of diversion became noticeably different in the low flow period of August (Graph 27)

with higher daily maximum occurring at the upstream riffle in comparison to the downstream riffle. A peak temperature of 19.3° C was recorded in the upper riffle on August 15th at 15:14. At this same time a temperature of 18.0° C was recorded in the downstream riffle. It is hypothesized that this depression in peak temperatures is due to stream water entering and leaving a large cobble/boulder bar that is below the point of diversion and directly above the downstream monitored riffle. The fish screen's bypass also runs through this bar and is potentially adding to the infiltration and cooling.



Graph 28 - Patterson Creek above Diversion #390 – water temperature in a pool and riffle habitat



Graph 29 – Patterson Creek below Diversion #390 - water temperature in pool and riffle habitats

Very little difference was documented between the temperature regimes in the riffle and pool habitats above and below the point of diversion (Graph 28 and 29, respectively). The Water Trust wished to monitor water temperatures in both riffles (characterized by well mixed waters that are representative of the ambient temperature of the reach) and in pools. The desire to monitor water temperatures in pool habitats was based on the documented preference for juvenile salmon and larger trout for these deeper habitats with slower velocities. Pools could also exhibit a cooler temperature regime if groundwater and/or hyporheic flow was percolating into the deeper scour hole. No significant temperature difference was seen between these two habitats in this reach of Patterson Creek and future water temperature monitoring efforts should be performed in the well mixed riffle habitats.

Biological Monitoring:

Direct observation surveys were performed in Patterson Creek on 7/3/2008 to document the presence of coho salmon in the reach to be affected by the Water Trust. Several hundred juvenile coho (estimate 300 – 350) were observed rearing in the complex habitat and deep water in the Pool_2 site. High densities of juvenile coho were using microhabitats characterized by a root wad combined with coarse woody debris and submerged terrestrial vegetation and a backwater with cover from instream and over head wood. The juvenile coho also occupied the open deep water with shade and adjacent fish cover.

The plunge pool (Pool_1) was occupied by approximately fifty juvenile coho salmon and rainbow trout. The juvenile coho were mostly using the bubble curtain created by the water plunging over a log that spans the entirety of the top of the pool. Three larger rainbow trout (6 inches) were observed occupying this plunge pools.

The pool upstream from the Pool_1 features a large rootwad associated with other coarse woody debris and a log “dam” that increases the pool’s depth and volume. This is the pool with the downstream pool temperature logger (Graph 25). There is a significant volume of complex low to no velocity water underneath the rootwad and woody debris aggregate. This area and the adjacent deep scour hole were occupied by a large number of coho (150+) with the larger coho in small niches directly under the coarse wood. Young of the year rainbow trout and one large rainbow trout (8 inches) were also observed in this pool with superb habitat.

The glide above this pool (Glide_1) offered a large surface area of water with pockets of suitable depth and velocity from large substrate cover and a large aggregate of coarse woody debris over and in the water on the river right margin. Approximately 140 coho were observed in the habitat unit. Some of the coho were observed utilizing the woody debris but most were observed distributed evenly throughout the unit using substrate cover. Larger and young of the year rainbow trout were observed.

The control pool offered deeper medium velocity waters with little cover excepting limited substrate cover. This pool was occupied by twelve coho and five rainbow trout

(one six inches). The coho were in deeper niches adjacent to the thalweg utilizing substrate cover while the larger trout occupied the middle of the deepest part of the scour hole. The relatively low density of coho in this pool with limited fish cover elements in comparison to the observations downstream demonstrates the role woody debris and submerged terrestrial vegetation plays in making microhabitats that are utilized at high densities.

A walking survey was performed from Diversion #390 to the Highway 3 Bridge on July 1st, 2008. Large amounts of salmonids were observed on this "streambank survey" utilizing pools and deep pockets with woody debris and/or overhanging terrestrial vegetation. The riparian canopy and vegetation along the streams margin was excellent throughout the reach until the alluvial braided section was approached above Highway 3. Little to no riparian vegetation occurs in this highly braided and wide section that is the point that Patterson Creek becomes disconnected at low flows.

Fall Leases:

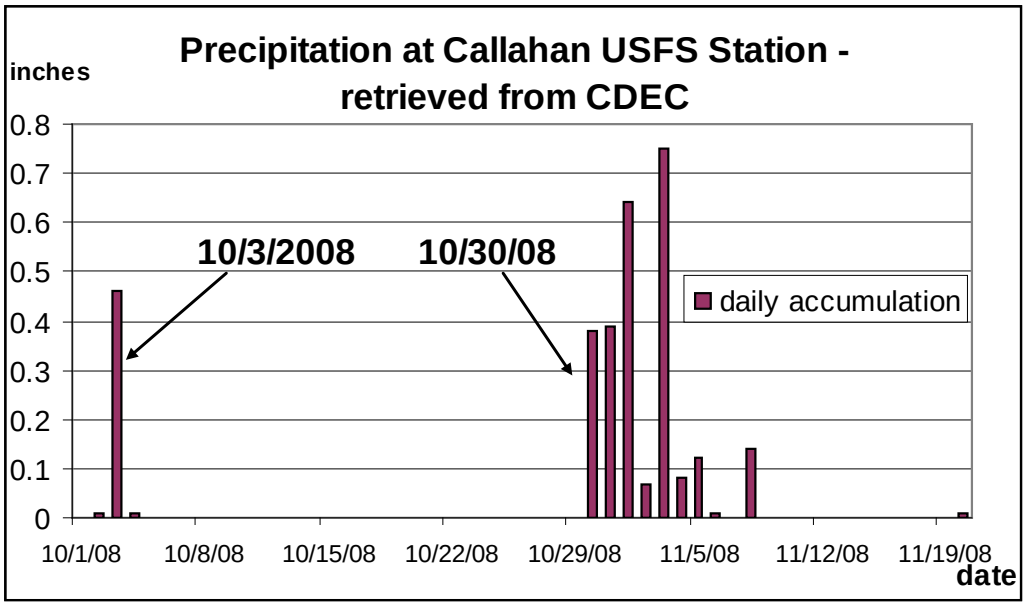
2008 Fall Lease Amounts by Scott River Water Trust

River Mile / Diversion Number	Date Began	Date Ended	Amount available (cfs)	Total acre-feet leased	Distance of benefit (miles)
Scott River					
RM 50.5 - #196	10-1-08	10-31-08	2.0	120.0	4
RM 50 - #198	10-4-08	10-18-08	0.7	19.6	4
RM 49 - #203	10-4-08	10-18-08	3.0	84.0	3
RM 46 - #223	10-29-08	11-04-08	4.0	56.0	46
TOTAL				279.6 acre-feet	50 miles[1]

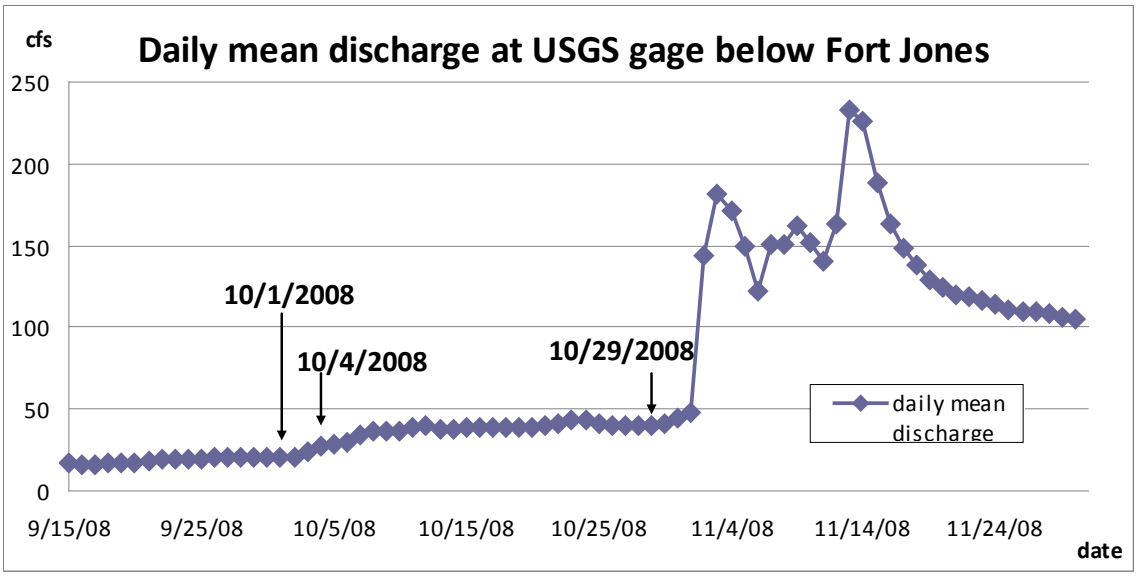
1/ Distance based on most upstream site.

Table 5 – Scott River fall leases

A series of fall leases were performed on adjudicated water rights in the main stem Scott River to improve the instream flows of the Scott River to aid the upstream migration of Chinook salmon and increase the possibility of Chinook accessing the spawning grounds located in the Scott Valley. A small precipitation event in early October and a much more significant and long lasting precipitation event in late October – Early November (Graph 30) occurred in the same time period as the fall lease amounts. This combination of natural increases in flow concomitant with the leasing of diverted waters increases the difficulty of monitoring the effect and persistence of leased instream flows (Graph 31 and Table 6).



Graph 30 - Daily accumulated precipitation at the USFS Station in Callahan – data retrieved from cdec.water.ca.gov on 3/12/2009.



Graph 31 – Certified daily mean discharge at USGS gage below Fort Jones
data retrieved from USGS Real Time Water Data Website at:
http://waterdata.usgs.gov/ca/nwis/dv/?site_no=11519500&agency_cd=USGS&referred_module=sw on 7/6/2009.

	RM	9/29/08 cfs	9/30/08 cfs	10/2/08 cfs	10/8/2008 cfs	10/9/2008 cfs	10/10/2008 cfs
Red Bridge	56.0	6.3			10.5		
Scott Above Fay	50.3	4.4		4.7	12.5		
Above French Creek	48.4	2.4		3.6	14.6		
Below French Creek	47.9	4.0			18.5		
Below Youngs Dam	46.5	2.4	1.8	2.3	9.9	11.7	14.8
Above Etna Creek	43.2	5.6	4.7	5.5	14	15.1	19.8
Below Etna Creek	42.6		5.4			15.2	
Below Eller	38.8		2.1	6.0		14.8	
Above Serpa	35.1	4.3	4.5	6.0	15.6	14.5	17.5
Below Moffett Creek	31.4					21.8	
Above Shackleford	25.0			14.5		33.5	
USGS gage	21.5	21	21	21	36	36	37

Table 6 – Measured and calculated instream discharge of the Scott River

Diversion #196 – Scott River above Fay Lane (RM 50.5)

Instream flow (discharge) measurements were performed above (Red Bridge) and below (Scott above Fay) Diversion #196 on September 29th before the transfer of 2.0 cfs of water to instream flow on October 1st. The stream discharge was measured on October 2nd at Fay Lane and above French Creek after the addition of 2.0 cfs to instream flows. An increase of 0.3 cfs at Fay Lane and 1.2 cfs above French Creek was observed in comparison to the pre project measurements. No change in the daily mean flow regime was observed at the USGS gage below Fort Jones but the Siskiyou RCD's continuous flow gages documented an increase in daily average flow below Youngs Dam (0.5 cfs),

above Etna Creek (0.8 cfs) and above Serpa (1.5 cfs) after the return of 2.0 cfs to instream flows on 10/1/2008 (Table 6).

Diversion #198 - Scott River above Fay Lane – (RM = 50)

Two discharge measurements were performed on 10/2/2009 to document the amount of water in Diversion #198 available for lease by the Water Trust. An initial measurement of 0.5 cfs of water was made in the unlined ditch at Fay Lane – approx. 3,000 ft. downstream of the fish screen. A discharge measurement directly below the fish screen documented 0.7 cfs of water. This measurement was performed when monitoring staff were concerned that the measurement at Fay Lane was not representative of the total volume of water at the point of diversion.

Diversion #203 - Scott River below Fay Lane – (RM = 49)

A discharge measurement of the diverted amount of water was performed on 10/2/2009 to verify that 3.0 cfs was being diverted at Diversion #203.

Discharge measurements were performed in the Scott River above and below Diversions #196 & #198 to document the instream flow before and after the Water Trust's transactions. Instream flows were documented above the transaction sites at the Red Bridge site below Callahan on September 29th (before) and October 8th (after). A gain of 4.2 cfs was observed between these two measurements. This gain is potentially attributable to the precipitation recorded in Callahan on October 3rd. Discharge measurements above the Fay Lane Bridge downstream of the two transaction sites show a gain of 8.1 cfs after the addition of 3.7 cfs to instream flows on 10/3/2008. This gain is significantly greater (3.9 cfs) than the gain attributable to environmental conditions documented at the site upstream of the transactions.

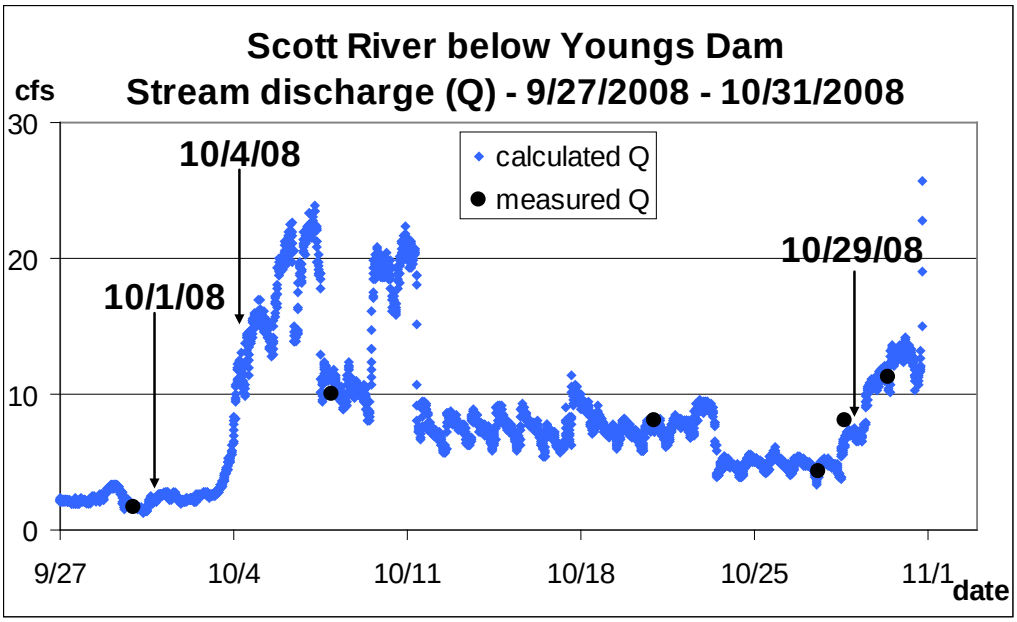
Diversion #223 – Youngs Dam Scott River (RM = 46)

Discharge Measurements performed for the Scott River Water Trust							
	Date	10/27/2008	10/28/2008	10/30/2008	10/31/2008	11/3/2008	11/4/2008
Scott River below French			**17.9**	**17.8**			
SVID		**12.1**	**9.5**	**4.9**	**6.1**	**11.8**	**12.3**
Scott River Below SVID		**4.3**	**8**	**11.2**			**137.6**

Table 7 – Instream and ditch discharge measurements for the SVID transaction

The instream flow of the Scott River and discharge in the SVID ditch directly downstream of the fish screen and bypass was monitored from October 27th until November 4th (Table 7). On October 29th 4.0 cfs of SVID's flow was leased by the Water Trust. This transaction was bracketed by flow measurements on the previous and subsequent days above (Scott River below French Creek) and below (Scott River below

SVID) the point of diversion. The flow regime appeared to be constant above the point of diversion and increased by 3.2 cfs below the point of diversion while it decreased by 4.6 cfs in the ditch. The fate of the "missing" 1.4 cfs of water is unknown. A significant amount of precipitation occurred on 10/30/08 – 11/3/2008 and the Scott River responded with an increase in flow.

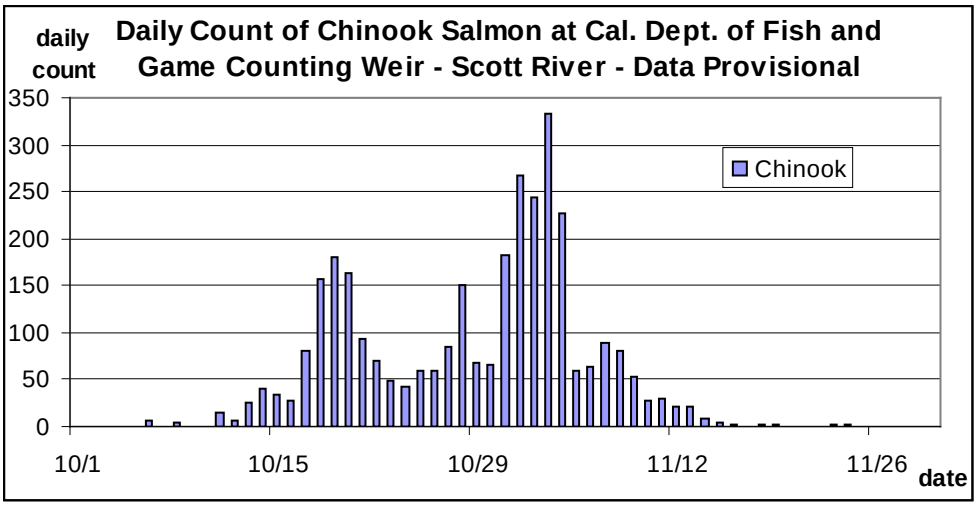


Graph 28 – Flow below Youngs Dam with dates of Water Trust transactions indicated

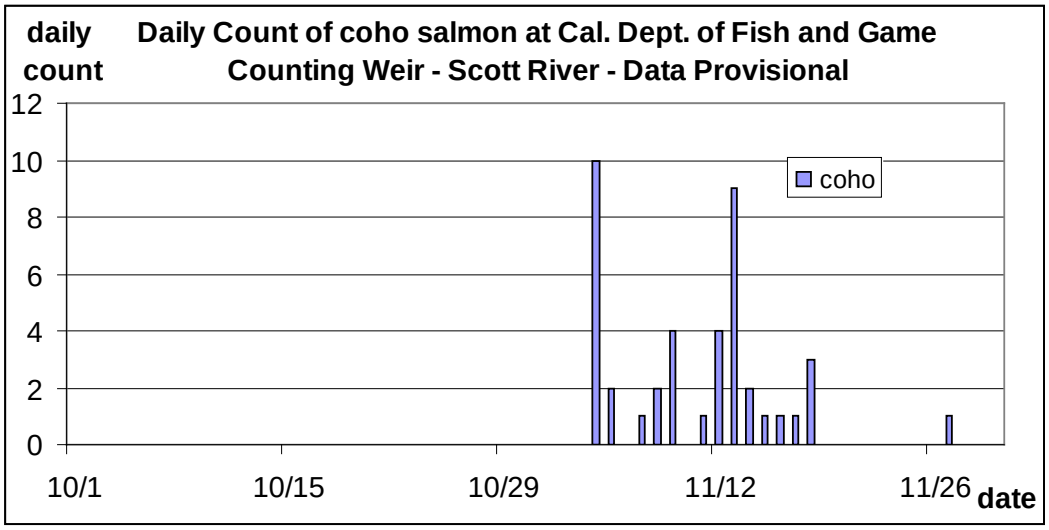
Biological Surveys:

The Siskiyou RCD performed cooperative Chinook salmon spawning ground surveys in the upper Scott Valley reaches during the fall of 2008. Personnel surveyed from above Fay Lane to below the mouth of Etna Creek two times a week. Live Chinook and redds were enumerated and carcasses were used to develop a population estimate through mark and recapture population estimates. Location of redds were captured with a hand held GPS unit and the number of redds attributed by each point was recorded. Adult Chinook were observed spawning above Fay Lane with higher densities below Youngs Dam (See Map). The first adult Chinook was observed above Youngs Dam (SVID) on the 20th of October.

The California Dept. of Fish and Game operated a video weir in the Scott River below the USGS gage at the upstream end of the Canyon reach. This weir enumerated the adult Chinook accessing the Scott Valley and total daily counts of Chinook and coho salmon were reported and are currently provisional (2/27/2009) (Graph 31 and 32).



Graph 30 – Daily Chinook counts at Scott River Video Weir – Provisional data courtesy of Morgan Knechtle – CDFG - Yreka



Graph 31 – Daily coho counts at Scott River Video Weir – Provisional data courtesy of Morgan Knechtle – CDFG - Yreka

Conclusion:

The Scott River Water Trust's activities during the summer and fall of 2008 were monitored to document the amount of water being leased and the leases affect on the in stream water quantity and quality. A variety of monitoring protocols were developed to address the key questions presented by the advisory committee of the Water Trust. Discharge measurements in ditch and in stream were used to verify the amount of water available for lease and the affect on in stream flows from lease activities, respectively. Pool volume measurements were performed before and after Water Trust activities at various flow regimes to document the affect of increased flows on pools which are preferred habitat for rearing juvenile salmonids. Stream temperatures were continuously monitored above and below the diversions participating in the Water Trust to document the activities effect on water temperature regime. Biological surveys were performed to document the presence of target species (coho and Chinook salmon) in the stream reach affected by Water Trust activities. These monitoring activities provide data to monitor the project level effectiveness of the Water Trust while documenting that Water Trust activities are being performed in reaches with suitable water quality parameters that are supporting the target species.

The Water Trust leased water in Patterson Creek a tributary not currently water mastered by DWR. The DWR Water Master has advised the Water Trust in 2007 and 2008 for all of the summer transactions in the French Creek and Shackleford Creek Watersheds. The Water Master has extensive experience in the water supply of these tributaries due to their past and present monitoring experience. The activities of the Water Trust in a non – Water Mastered tributary of the Scott River necessitated the gathering of base line data regarding the stream's water supply, connectivity and stream temperature regimes. The Siskiyou RCD documented the amount of water being diverted at the onset of the transaction and performed measurements to estimate the potential volume of diverted water through the transaction period. The RCD also performed extensive in stream flow, pool volume and water temperature monitoring in Patterson Creek to determine the amount and quality of suitable habitat at unimpaired base flow. This data can be used to evaluate the activities in Patterson Creek in 2008 and advise future Water Trust transactions in this watershed.

The stream temperature monitoring documented a negligible effect on stream temperatures due to the Water Trust's activities. Suitable water temperature ranges for rearing salmonids were documented in two locations in which continuous summer water temperatures did not previously exist – Miners Creek and Patterson Creek. Stream temperatures in pool and riffle habitats were almost identical in all reaches except the alluvial reach of lower French Creek in which complex processes of stream flow loss and accretion created greater local variability in surface water temperatures.

Instream discharge measurements documented the increased stream flows due to the activities of the Water Trust. Investigations into the lower reach of French Creek documented a complex reach with areas of surface flow loss and areas of accretion, necessitating the performance of multiple instream flow measurements at different

locations to document the effect of the Water Trust's activities. Periodic flow measurements after the Water Trust's transactions documented water availability as Patterson Creek and Lower French Creek approached and persisted through base flow conditions. A combination of periodic flow measurements and continuous stream gaging documented the instream flow at multiple points during the Water Trust's fall activities. This interpretation of the fall flow monitoring (and the attribution of affect to the Water Trust's activities) was often complicated by precipitation events occurring during the same time as the Water Trust's activities.

Pool volume measurements in Patterson Creek documented an increase in pool volume after the Water Trust's transaction. The monitored pool volumes in Patterson Creek then decreased as the stream reached base flow in mid-September. Base flow conditions persisted in Patterson Creek through late October of 2008. Pool volume measurements in Miners Creek documented an increase in pool volume after the two transactions in late July and Mid – August. Unlike Patterson Creek no subsequent decrease in pool volume was documented in Miners Creek and it is hypothesized that base flow conditions had been reached by the time of the first transaction.

Biological surveys documented the presence of target species (coho and Chinook salmon) in all of the reaches affected by the Water Trust's summer activities except in Miners Creek. Landowner access for biological surveys was denied on Miners Creek during the 2008 monitoring activities. Besides the presence of target species many of the affected reaches offered features indicative of high quality aquatic habitat including robust riparian vegetation and instream fish cover elements. Adult surveys performed in the Scott Valley documented the presence and successful spawning of Chinook salmon during the 2008 season in and above the reaches in which transactions occurred.

Discussion:

Extensive monitoring activities were performed in 2008 to document the various transactions of the Scott River Water Trust during the summer and fall. Physical and biological parameters were monitored to document the effectiveness of the Water Trust's activities and document that the activities were performed in reaches with the target species present and/or suitable water quality parameters. The 2008 monitoring program was a significant expansion of the activities performed in 2007. Several observations were generated during this monitoring season: 1) changes in environmental conditions can "mask" or overwhelm effects attributable to the Water Trust's activities, 2) leasing water before the system reaches base flow introduces the difficulty of determining the "potential" diversion volume as the stream approaches base flow especially in streams with limited knowledge of water supply and 3) transactions that effect complex reaches (e.g., stream reaches with areas of surface flow loss and/or accretion) can be difficult and more time consuming to monitor due to the increased variability in water quality and quantity. The difficulty of accurately measuring small volumes of water (less than 1.0 cfs) in channel and in ditches with a current meter was encountered in many of the tributary transactions in which base flows were a fraction of a cubic foot per second.

Various potential monitoring activities to document the population and condition of coho salmon in areas affected by the Water Trust activities were discussed in the preparation for the 2008 season. The biological monitoring activities performed in the summer of 2008 were limited to documenting the presence of coho salmon in stream reaches directly affected by the increased instream flows. Resources were not available to perform a more rigorous assessment of the Water Trust's affect on the condition and survival of the fishery. The execution of a rigorous biological survey of population and/or condition of the fishery before and after the Water Trust's activities would be a significant study in itself and would probably require a source of funds independent and in excess of the Water Trust's operating and monitoring budget.

Concerns have arisen regarding the Water Trust's operation and monitoring budget in respect to the number of transactions that occurred in 2008. Assessment of the monitoring activities performed in 2008 with the objective of documenting the effect of the Water Trust's activities in the most cost effective manner indicates several activities that could be curtailed. The pool volume measurements are the first activity that should be limited if budgets necessitate. Additionally, the decision to monitor physical parameters (e.g. instream flow) during the duration of the lease and not just before and after the transaction occurs significantly increases the amount of monitoring effort.

It should be noted that multiple monitoring activities in the Scott River that are not funded by the Water Trust (e.g. adult coho and Chinook surveys, various flow gages and the activities of the DWR Water Master) are crucial to direct the location of Water Trust activities and monitoring the effect of activities.

Bibliography:

California Data Exchange Center (CDEC) – Department of Water Resources cdec.water.ca.gov

Flosi, et al., 1998 – California Salmonid Stream Habitat Restoration Manual – 3rd Edition

Hardy, T.B. and R.C. Addley, *Evaluation of Instream Flow Needs in the Klamath River, Phase II Final Report*, prepared for the U.S. Department of Interior, Institute for Natural Systems Engineering, Utah Water Research Laboratory, Utah State University, Logan, Utah, November 2001.

Interagency Real Time Smoke Monitoring Website - www.airsis.com data retrieved on 5/21/2009

Rantz, S. 1982. Measurement and Computation of Streamflow: Volume 1. Measurement of Stage and Discharge. US Geological Survey Water Supply Paper 2175. http://pubs.usgs.gov/wsp/wsp2175/