Final Report

Summary Report of Water Temperature and Juvenile Salmonid Presence/Absence Monitoring, May-October 2007, Mattole River Watershed

Submitted in partial fulfillment of

Task Order 002, Cooperative Agreement BAA020030
Bureau of Land Management, Arcata Field Office

Tasks 2.4, Agreement No. 02-128
California Coastal Conservancy, Mattole River and Range Partnership

Proposition 40 Integrated Watershed Management Program
Grant # 06-141-551-0

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Project Description

During spring through fall 2007 Mattole Salmon Group personnel placed and retrieved 72 continuously recording thermographs (Hobo Water Temp Pro and Hobo Tidbit data loggers, herein referred to as "loggers") in the mainstem Mattole River and selected tributaries to monitor water temperature (Figure 1). In 2007, loggers were placed in 26 tributary reference reaches, from Ancestor Creek (RM 60.8) to Stansberry Creek (RM 1.3) and in the mainstem Mattole River upstream of monitored tributaries. Six historical mainstem reference reaches were also monitored, including the middle Mattole Estuary (RM ~0.5), deep and shallow locations at the Wingdam pool (RM 2.9; a restoration site near the MSG Office), the Ettersburg Bridge (RM 42.3), Junction Hole (RM 52.7), and Metz Bridge (RM 56.9). Air temperature monitoring occurred at four sites, spread geographically thoughout the Watershed: the Mattole estuary (RM ~0.5), Honeydew Creek (RM 26.5 +~1.0), the Ettersburg Bridge (RM 42.3), and at Metz Bridge (RM 56.9) near Whitethorn. In the upper Mattole River, loggers were placed in seven locations in conjunction with dissolved oxygen and low-flow monitoring near the headwaters. Ten temperature loggers were deployed at channel monitoring sites to gain further information on tributaries in the Mattole Watershed. Additional temperature monitoring devices included possible future restoration project sites and MSG salmonid population monitoring sites, including at the downstream migrant trap (RM 3.8), and at shallow and deep locations in the upper Mattole Estuary (~RM 1.0). See Table 1 for logger serial numbers, placement dates, locations and results.

In most cases, direct underwater observation counts of juvenile salmonids were conducted at the time of logger placement and retrieval in each Mattole tributary. In selected mainstem locations with historical dive observation data, snorkel surveys were also conducted (see Table 2 for snorkel survey results). The objective of these snorkel surveys was to determine the distribution of three species of juvenile salmonids, and to document their relative abundance. Calibrated temperature loggers were placed between May 1 and July 12, 2007. Loggers were retrieved between October 1 and October 30, 2007.

Background

Water temperature fluctuations can affect salmonids during each phase of their life history. "Most aquatic organisms, including salmon and steelhead, are poikilotherms, meaning their temperature and metabolism are determined by the ambient temperature of water. Temperature therefore influences growth and feeding rates, metabolism, development of embryos and alevins,

timing of life history events such as upstream migration, spawning, freshwater rearing, and seaward migration, and the availability of food. Temperature changes can also cause stress and mortality" (Coates, et al. 2002).

The MSG Temperature Monitoring project focuses on the freshwater life stage of juvenile Chinook salmon (*Oncorhynchus tshawytscha*), Coho salmon (*Oncorhynchus kisutch*), and Steelhead trout (*Oncorhynchus mykiss*), as well as adult summer steelhead in the Mattole River. Through monitoring temperatures throughout the watershed in the mainstem and tributaries, the Mattole Salmon Group is attempting to better understand the status and needs of the three anadromous salmonid species in the Mattole watershed.

Elevated water temperatures and excessive sediment in the Mattole River and its key tributaries has resulted in diminished or completely absent minimum threshold habitat conditions for salmonid survival. Adult and juvenile salmonid viability partly depends on the availability of cold water, a scarce but crucial component in this degraded watershed.

Excessively high summertime water temperatures in the Mattole have been identified as a primary limiting factor in the survival of native anadromous fish stocks (Downie et al. 2002, Coates et al. 2002). In laboratory studies, temperatures of 68°F and greater have been documented as being stressful to juvenile coho and Chinook salmon (Brett 1952), and temperatures of 75.0-77.0° F may kill these species (Brungs and Jones 1977, Brett 1952).

Figure 1 shows the criteria used by the Mattole Salmon Group in this report to evaluate suitable thermal habitat at water temperature monitoring locations throughout the watershed. Criteria used to determine temperature suitability includes measures of chronic temperature exposure (MWAT, MWMT) as well as short-term high temperature exposure survival (maximum temperature) and length of temperature stress (days >68°F).

Figure 1. Criteria used to evaluate salmonid habitat in the Mattole River, 2007 MSG Temperature Monitoring Report.

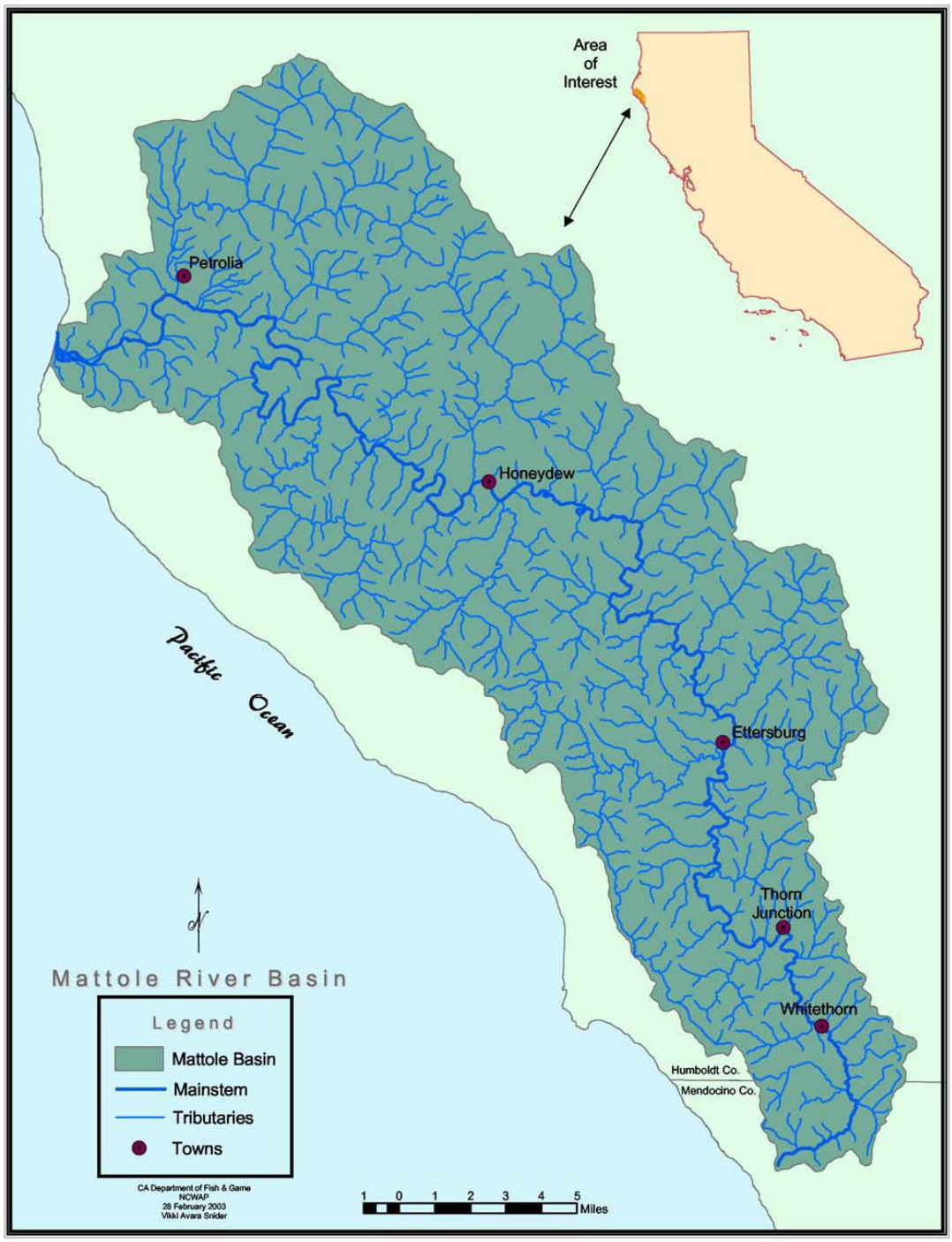
Criteria	Temperature	Reference
Prolonged Temperature Stress	Days >68 F	Brett 1952
Short-term Maximum Temperature (50% survival)	74.7°F (coho) 75.0°F (steelhead)	Brungs and Jones 1977
Maximum Weekly Average Temperature (MWAT)	>63.0°F (coho) >66.0°F (steelhead)	Coates et al. 2002
Maximum Weekly Maximum Temperature (MWMT)	>65°F MWMT (coho)	Welsh et al. 2001

MWMT and MWAT are used as quantitative measures to interpret the results of 2007 Temperature Monitoring in the Mattole. Maximum weekly average temperature (MWAT) is the highest value of the floating weekly average temperature. In other words, MWAT is the greatest mean of daily average temperatures over any 7-day period during the study (Brungs and Jones 1977). Maximum weekly maximum temperature (MWMT) is the highest average of maximum daily temperatures of any 7 days during the study period. MWMT and MWAT are used to

evaluate chronic stress due to water temperature exposure, while maximum temperatures are used to evaluate acute thermal stress (50% survival) during short-term high temperature exposure.

Duration as well as severity of exposure to sub-lethal water temperatures affects long-term salmonid survival. Effects are cumulative; the longer the duration of thermal stress at sub-lethal levels, the more negative the effects on long-term survival (Ligon et al., 1999). Duration of exposure to temperature stress in monitoring locations in the Mattole is evaluated based on the number of days maximum daily temperature exceeded >68°F.

Figure 2. Mattole Watershed



Source: Downie et al. 2003

Literature used to evaluate thermal habitat suitability for salmonids in the Mattole River and tributaries in this report includes laboratory studies of water temperature effects on salmonids and field studies of salmonid occurrence, abundance, and distribution in the field in relation to high temperature.

Brett (1952) determined biological temperature thresholds for Chinook and coho salmon based on physiological effects of water temperature in laboratory studies. Observations of salmonids in laboratory conditions indicated an upper lethal water temperature of 77°F for Chinook and coho salmon. Based on responses of fish to laboratory experiments, prolonged exposure to water temperatures greater than 68°F were determined as stressful to salmonids (Brett 1952).

Using upper lethal limit temperature and optimal temperature established in lab studies of coho and steelhead, Brungs and Jones (1977) calculated MWAT and short-term maximum temperature to quantify tolerances of salmonids to chronic and acute temperature exposure in the field during different life stages. Based on their lab results, they concluded growth was the life stage most sensitive to modified temperature due to the many physiological functions required. They determined acute short-term temperature thresholds (50% survival) were 74.7°F for coho and 75.0°F for steelhead. Salmonid distribution (in relation to temperature) observed during later field studies supported the accuracy of their predicted upper short-term thresholds. McCullough (1999) concluded that upper short-term temperatures of approximately 22-24° C (71.6-75.2°F) limit salmonid distribution. However, McCullough (1999) also noted that competitive interactions between fish species can limit salmonids at temperatures 2-4° C lower than the range of total elimination.

A recent study of the distribution of juvenile coho salmon in relation to temperature in 21 tributaries of the Mattole River was completed by the Mattole Salmon Group and Redwood Sciences Laboratory (Welsh et al. 2001). The study found juvenile coho salmon only in tributaries with MWAT values less than 62.2º F, and MWMT values less than 64.6º F. MWAT is determined by the highest average of mean daily temperatures of any 7-day period, and MWMT is determined by the highest average of maximum daily temperatures over any 7-day period. Coho were found in 16 of the 18 streams surveyed including the mainstem Mattole.

Recently, water quality in the Mattole was determined as impaired due to sediment and temperature by the State of California under the Clean Water Act, Section 303 (d). Impacts on the anadromous salmon fishery in the Mattole were identified as the primary adverse effect of elevated sediment load and temperature. All three species of salmonids in the Mattole are listed under the Endangered Species Act. The EPA established Total Maximum Daily Loads (TMDL) for Sediment and Temperature in the Mattole River in 2002. Coates et al. (2002) completed a literature review to determine temperature tolerance criteria for salmonids in the Mattole. MWAT was used as the primary statistical measure for interpretation of stream temperature conditions. Based on past lab and field studies, Coates et al. determined MWAT stream temperature values (See Figure 3) to characterize the temperature quality of surface waters in the Mattole River watershed.

Figure 3. Summary of temperature tolerances of coho salmon and steelhead (Coates et al. 2002).

Descriptor	Coho Salmon	Steelhead
Good	<15° C (<59.0° F)	<17° C (<63.0° F)

Marginal	15°-17° C (59.0°-63.0° F)	17°-19° C (63.0°-66.0° F)
Poor/Unsuitable	>17° C (63.0° F)	>19° C (>66.0° F)

Many of the Mattole's tributaries and portions of its mainstem exceed 80º F during the summer months when the flow is low and solar radiation is high. "However, discrete areas of colder water can be created by tributaries, groundwater seeps, inter-gravel flow, deep pools, and areas separated from currents by obstructions" (Nielsen et al, 1994). Salmonids are able to access these pockets of colder water, called thermal refugia, as an avoidance strategy to survive during periods of elevated temperatures.

"The existence of these thermal refugia allows salmonids to persist in these reaches of otherwise poor or marginal habitat (Coates et al. 2002)." Temperature and dive monitoring in the Mattole has focused on identifying thermal refugia and cool-water tributaries and establishing presence and distribution of salmonids in relation to temperatures throughout the watershed. The decrease in quality and extent of freshwater habitat has inevitably resulted in considerably reduced run strength, particularly for Chinook and coho native to the Mattole River.

Now completing our thirteenth year of temperature monitoring in the Mattole's tributaries and mainstem, the Mattole Salmon Group has begun to identify trends in the consistent presence and absence of juvenile salmonids at certain locations in the watershed, and how species presence correlates to summertime water temperatures.

Project Goals

The following goals for water temperature monitoring in the Mattole watershed were identified by staff of the Mattole Salmon Group:

1. Establish reference points, to determine how temperatures at set locations with relatively stable conditions change from year to year.
2. Help determine where and when water temperatures are stressful or lethal to salmonids, and where refugia are located when temperatures spike.
3. Document temperatures prior to and/or subsequent to timber harvest in specific locations.
4. Help determine where instream restoration and revegetation projects are best directed.
5. Monitor and document recovering tributaries.
6. Monitor and document refugia in the lower mainstem Mattole.
7. Locate and document cold-water areas (in predominantly warm reaches of stream), such as seeps and cold stratified pools.
8. Monitor lower and middle river tributaries to establish which tributaries offer cool-water oversummering habitat where the mainstem reaches high temperatures.
9. Monitor temperature at low-flow monitoring locations in the headwaters.
10. Monitor streams to establish to establish coho presence/absence in relation to temperature and other water quality parameters.
11. Monitor streams and mainstem locations to determine Chinook oversummer distribution in relation to temperature and other water quality parameters. Develop threshold temperature standards for Chinook in the Mattole Watershed.

Each monitoring site was chosen according to its ability to meet one or more of the above goals. The overall goal in 2007 was to establish baseline data in tributary reference locations and evaluate ambient river temperatures in the mainstem, and document conditions and salmonid habitat utilization in tributaries.

Six sites in the upper Mattole River were also chosen for temperature monitoring in conjunction with low-flow and dissolved oxygen monitoring in the headwaters. In recent years, flows in the headwaters of the Mattole have subsided to mere groundwater flows and become a series of disconnected pools. Sites were identified in the upper mainstem with suitable temperatures for juvenile salmonid oversummering and areas where temperature in the upper mainstem exceeds thresholds for juvenile survival.

Procedures

Temperature Logger Calibration

Temperature loggers operate under battery power for the duration of the field season.
Loggers contain a microchip which records electronic data generated by a sensing device. Calibration tests before field placement were done to verify that each device operated within the manufacturer's specified limits (+/- 0.5° C). Monitors that deviated from this range upon testing were not placed in the field. The same calibration process was performed with loggers after they were retrieved. Data that deviated from the acceptable accuracy range were discarded.

Loggers were calibrated using the following procedure:

1. All recording thermometers were launched to record temperature every 10 seconds.
2. All recording thermometers and a laboratory-certified calibration thermometer were placed in an ice chest filled with ice water. The ice water was stirred every two minutes.
3. The time and indicated temperature of the calibration thermometer were recorded every five minutes for 30 minutes.
4. Recording thermometers were taken out of the ice chest.
5. Data were downloaded from each temperature logger and examined to ensure proper function of each recording thermometer. Loggers that recorded temperatures which deviated more than +/- 0.5ºC from the temperatures recorded at the same time by the calibration thermometer were not used in the field.

Logger Installation

Instream temperature loggers were placed in or near the thalweg, where water turbulence and mixing was greatest, and at sufficient depth (greater than one foot if possible) to prevent exposure at low flows. Typically, suitable sites were located in runs, riffles, or heads of pools, but not in slack water, backwater pools, at the bottom of pools (except when measuring for stratification) or in shallow riffles that may become exposed. Loggers were also placed out of direct sunlight. Using nylon cord, and in some cases rocks, temperature loggers were secured in locations where they would not be dislodged during high flows and were hidden or camouflaged from human detection.

The Optic Stowaway, Hobo Water Temp Pro, and Tidbit loggers were launched to record hourly temperature for the duration of the field season. On "Rite-in-the-Rain" field forms, the following information was recorded when each logger was placed, and when applicable, when it was

retrieved: time, date, air and water temperature taken by hand-held thermometer, description of general and precise placement location of logger, placement depth of logger, depth of logger upon retrieval, and maximum pool depth at placement location.

Data Management

Each temperature logger was launched with its serial number and placement location recorded. All data was downloaded in Boxcar Pro software and exported to Excel, and data was stored in both formats. Field location, serial number, date of placement, and date of retrieval were recorded in a separate Excel file (Table 1). Data that deviated significantly from the expected range or from previously obtained data from that site was evaluated for accuracy and adherence to placement protocols. In Excel, all data obtained prior to, and following removal from field placement (when the monitor was not in its field position) was discarded and removed from the data file. This process is also known as "trimming" the data. "Trimmed" and "raw" data were stored in separate files.

Boxcar Pro temperature data files were also uploaded into Klamath River Information System for the Mattole River (KRIS Mattole). 2007 Temperature monitoring data were appended to the 2000-2006 temperature source table. New KRIS topics were created with updated information for all 2007 Temperature Monitoring locations. Figures from the KRIS database were used to analyze and interpret results during the 2007 season and over the course of 2000-2007 temperature monitoring in the Mattole.

Snorkel Survey Methods

Our temperature-related snorkel surveys followed a modified ten-pool protocol for determining presence/absence of juvenile coho salmon, as employed by the California Department of Fish and Game (Preston et al. 2002).

The scope of the Mattole Salmon Group's snorkel surveys was limited by project funding and in some streams by lack of landowner permission. It was often unfeasible to survey reaches in the lower, middle and upper areas of a stream. At many monitoring sites only a short stretch of stream could be accessed, sometimes less than ten consecutive pools. In many instances, accessible survey reaches did not contain ten pools with relatively suitable coho habitat. Therefore, when a species was not observed in a sampling that was less complete than that employed in the above-mentioned modified ten-pool protocol, that species could not justifiably be declared "absent" in an entire stream.

Another way in which the Mattole Salmon Group's temperature-related snorkel surveys differed from a standard modified ten-pool protocol, is that when a coho salmon was sighted, the survey continued until ten pools, or the maximum number of pools possible, were surveyed. This allowed for a broader sampling of relative abundance.

Results and Discussion

Basinwide

Floating Weekly Maximum Temperatures in many locations were above thresholds set for coho presence by Welsh et al. (2001). Additionally, Maximum Weekly Average Temperatures in

many mainstem monitoring locations, especially in the middle and lower river, indicated unsuitable thermal habitat for steelhead and coho (Coates et al. 2002).

The mouth of the Mattole River remained open to emigrating juveniles until July 3, 2007. 2007 streamflow in the Mattole River at Petrolia was similar to median streamflow based on 59 years on record for most of the summer (Data from USGS). Streamflow fell below 100 cubic feet per second in the mainstem Mattole River at Petrolia in mid-June, much earlier than last year when there were late spring rains (See Figure 4). An unusual storm event on July 18 resulted in a temporary increase in mid-summer flow. By September, streamflow was slightly lower than the estimated median daily streamflow. Foggy, cool weather in the late summer and early fall resulted in reduced transpiration and evaporation, preventing more extreme low flows.

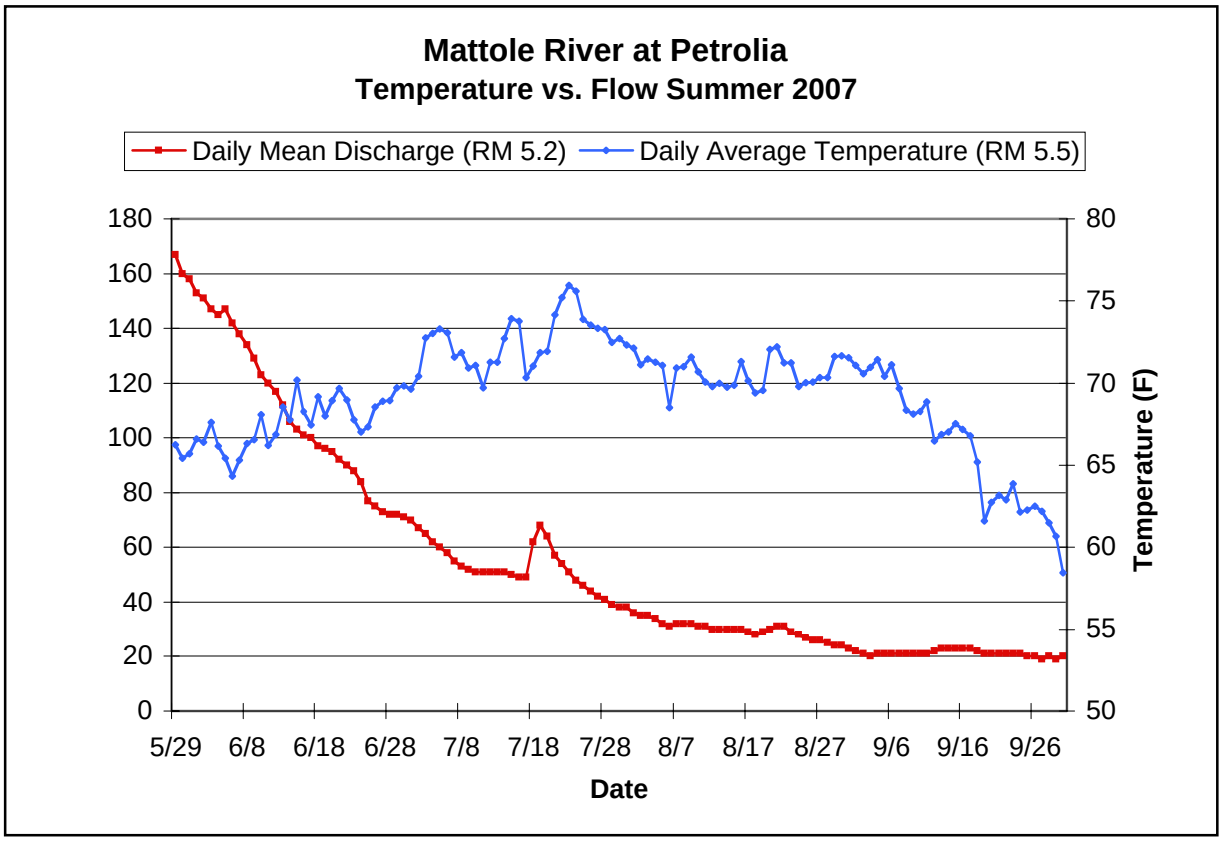


Figure 4. Daily Average Streamflow vs. Daily Average Temperature in the Mattole River at Petrolia (Summer 2007).

The highest water temperature recorded at any location this season was 83.15° F, which occurred in the mainstem Mattole River upstream of Clear Creek (RM 6.1) on July 23rd. In this section of the lower Mattole, the river channel is extremely aggraded and there is lack of any significant riparian vegetation to shelter the river from the heating of solar radiation. The maximum temperature recorded in 2006 was several degrees higher; in the mainstem Mattole at Saunders Creek (RM 20), temperature reached a maximum of 86.85° F on 7/23/06. Peak 2007 temperatures were warmer than average temperatures since 2000 in locations with multiple years

of record, but cooler than many maximum temperatures recorded in 2006, probably the warmest of recent years.

The lowest maximum water temperature (57.68° F) was recorded in Helen Barnum Creek (RM 58.9 +0.1) on 7/29/07. The seasonal maximum temperatures at most monitoring locations were reached either between 7/5-7/6/07, 7/23-25/07, or on 8/1/07. The seasonal maximum water temperatures corresponded to peaks in air temperatures throughout the Watershed (See Figure 5). Air temperatures in Whitethorn were usually cooler than air temperatures in Ettersburg or at the Mattole Estuary.

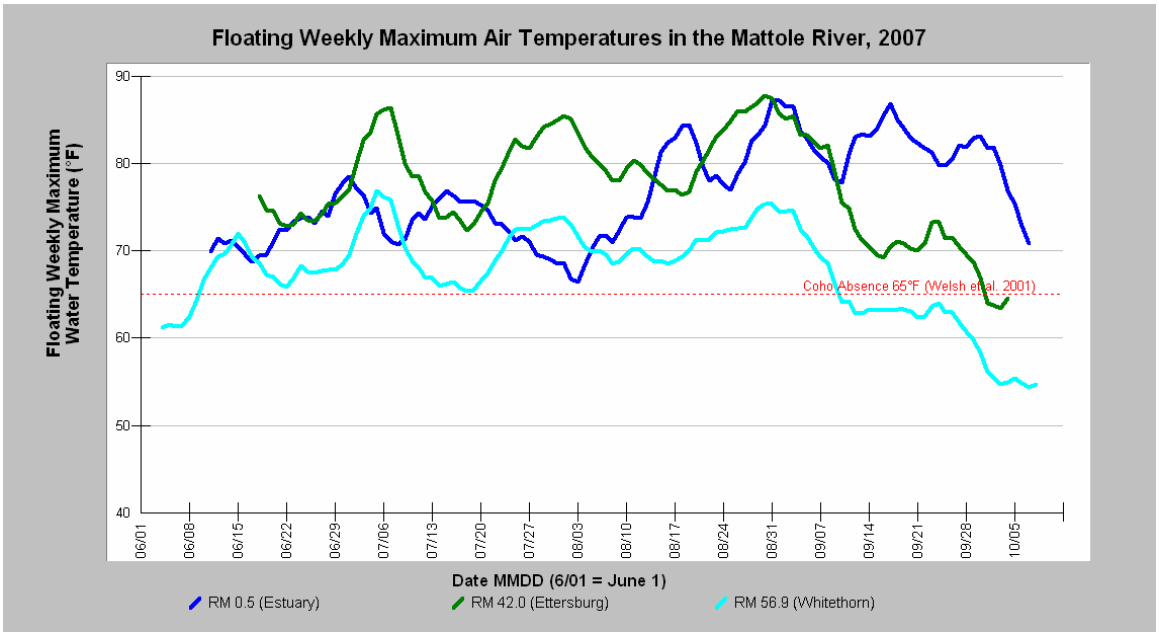


Figure 5. 2007 Floating Weekly Maximum Air Temperatures in the Mattole Watershed.

Upper Mainstem Mattole

In 2007, twelve temperature monitoring locations were selected in the upper Mattole to determine locations with suitable temperatures for juvenile salmonid oversummering in the upper mainstem (See Table 1).

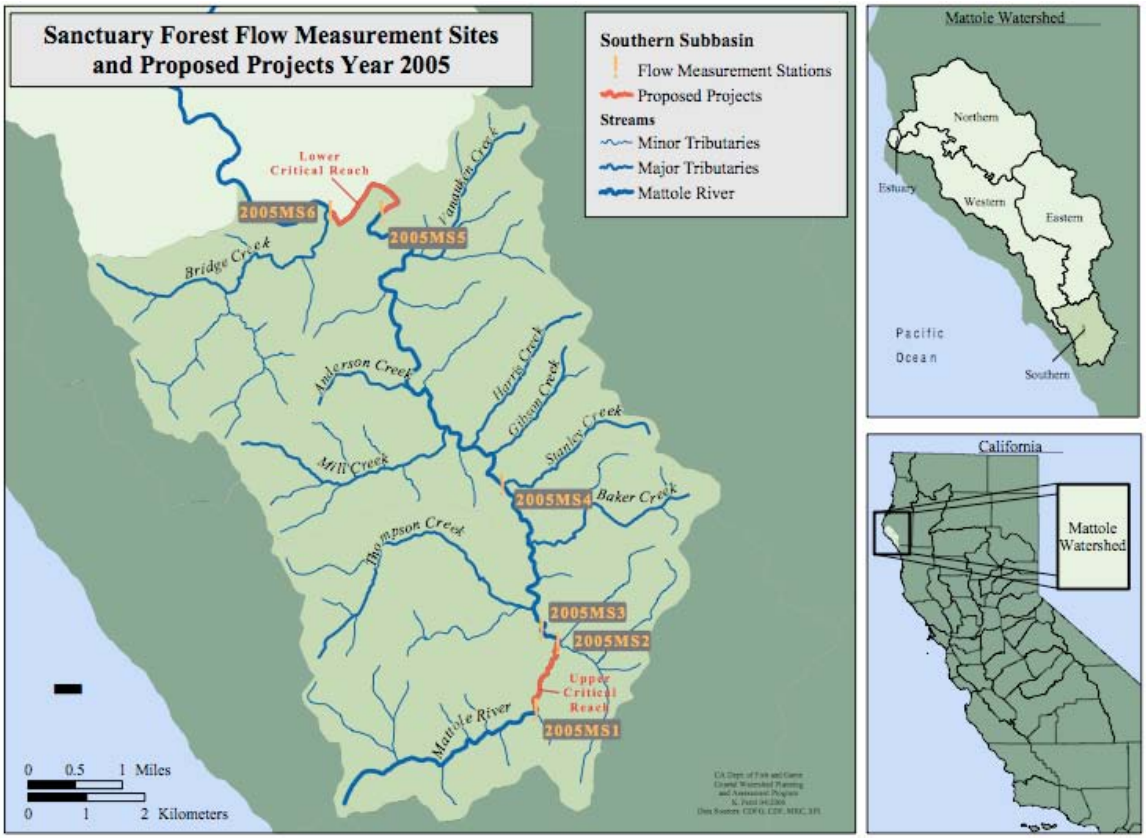


Figure 6. Upper Mattole Low-flow and Temperature Monitoring Locations.
Source: Sanctuary Forest

Ten of upper Mattole temperature monitoring sites were in the southern subbasin (upstream of Bridge Creek, RM 52.1). Two downstream sites were the Mattole at the Big Finley Creek pool (RM 47.4) and upstream of Eubanks Creek (RM 47.8). Seven sites (MS-1 (RM 59.4), MS-2 (RM 58.8), Mattole us Thompson Creek (RM 58.5), Mattole us Baker Creek (RM 57.8), Mattole at Metz Bridge (RM 56.9), MS-5 (RM 53.0), and MS-6 (RM 52.2)) were selected in conjunction with MSG dissolved oxygen monitoring and Sanctuary Forest low-flow monitoring of the Mattole headwaters (See Figure 6). Temperature monitoring at RM 60.8 (just ds confluence with Ancestor and McNasty Creeks) provided information regarding temperatures near the Mattole headwaters. Mattole at Metz Bridge (RM 56.9) was chosen as the main reference location for water and air temperatures in Whitethorn due to continuous monitoring since 2002. Mattole at Junction Hole (RM 52.7) was another mainstem reference location. 2007 floating weekly maximum temperatures recorded at Metz Bridge (RM 56.9) were moderate in comparison to 2002-2005 temperatures, and cooler than 2006 temperatures, which were the highest on record (See Figure 7).

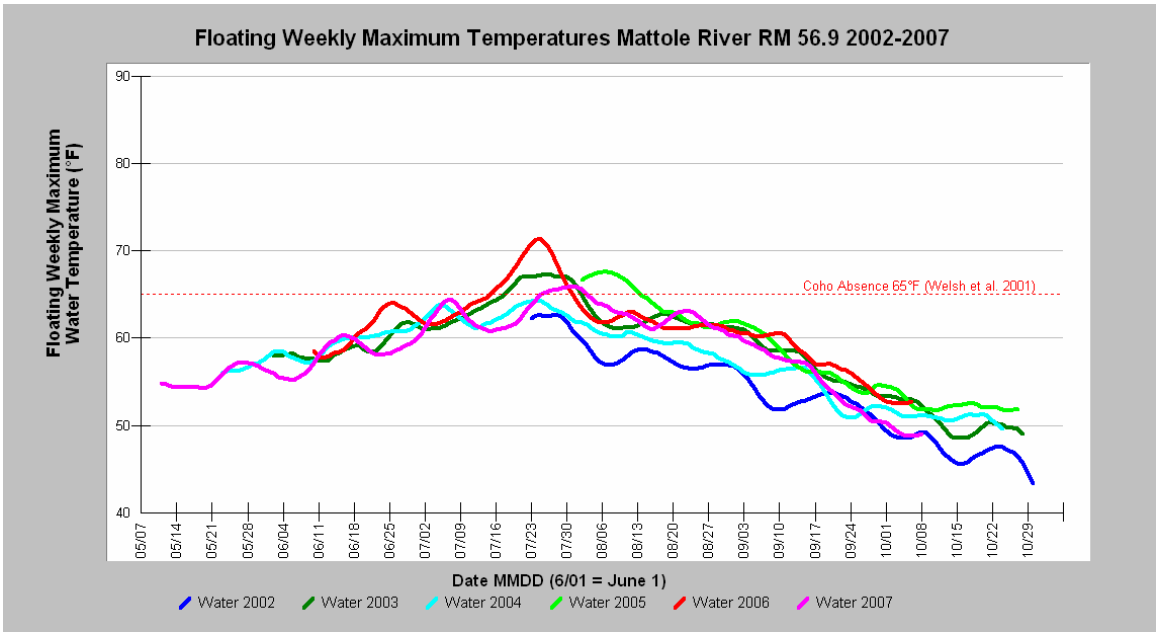


Figure 7. 2007 floating weekly maximum water temperatures in the Mattole at River Mile 56.9.

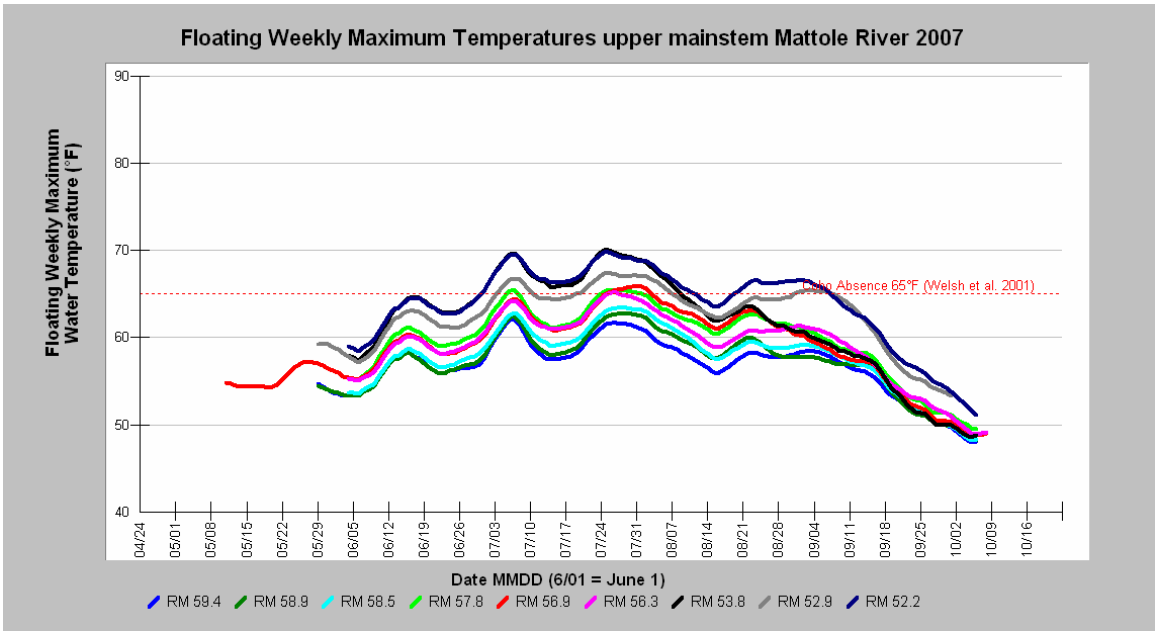


Figure 8. 2007 floating weekly maximum water temperatures at Mattole mainstem temperature monitoring locations in the southern subbasin, River Mile 59.4 to River Mile 52.2. Sites listed downstream (left) to upstream (right). See Table 1 for more information on locations.

Floating Weekly Maximum Temperatures exceeded 65°F in six of ten locations, including Mattole upstream of Baker Creek (RM 57.8), Mattole at Metz Bridge (RM 56.9), Mattole upstream of Upper Mill Creek (RM 56.3), MS-5 (RM 53.8), Mattole at Junction Hole (RM 52.9), and MS-6/Mattole upstream of Bridge Creek (RM 52.2), indicating unsuitable temperatures for

coho rearing (Welsh et al. 2001) (See Figure 8). Temperatures in the upper mainstem exceeded the coho threshold during peak temperatures from mid to late July. Floating weekly maximum temperatures remained below 65°F at the four uppermost locations (Mattole upstream of Ancestor Creek (RM 60.8, not pictured), MS-1 (RM 59.4), MS-2 (RM 58.9), and Mattole upstream of Thompson Creek (RM 58.5)). Although the uppermost locations are thermally most favorable for coho, low-flow and resulting water quality factors remain problematic for oversumering salmonids here. This emphasizes the importance of deep pool habitat and water conservation, especially in the coolest and most thermally favorable area of the Mattole mainstem near the headwaters.

Downstream of the southern subbasin, floating weekly maximum temperatures were warmer than 65°F in two upper Mattole locations. Temperatures recorded in the pool at Big Finley Creek were cooler and fluctuated less than those recorded upstream of Eubanks Creek in a shallower location with less favorable oversummering habitat (See Figure 9).

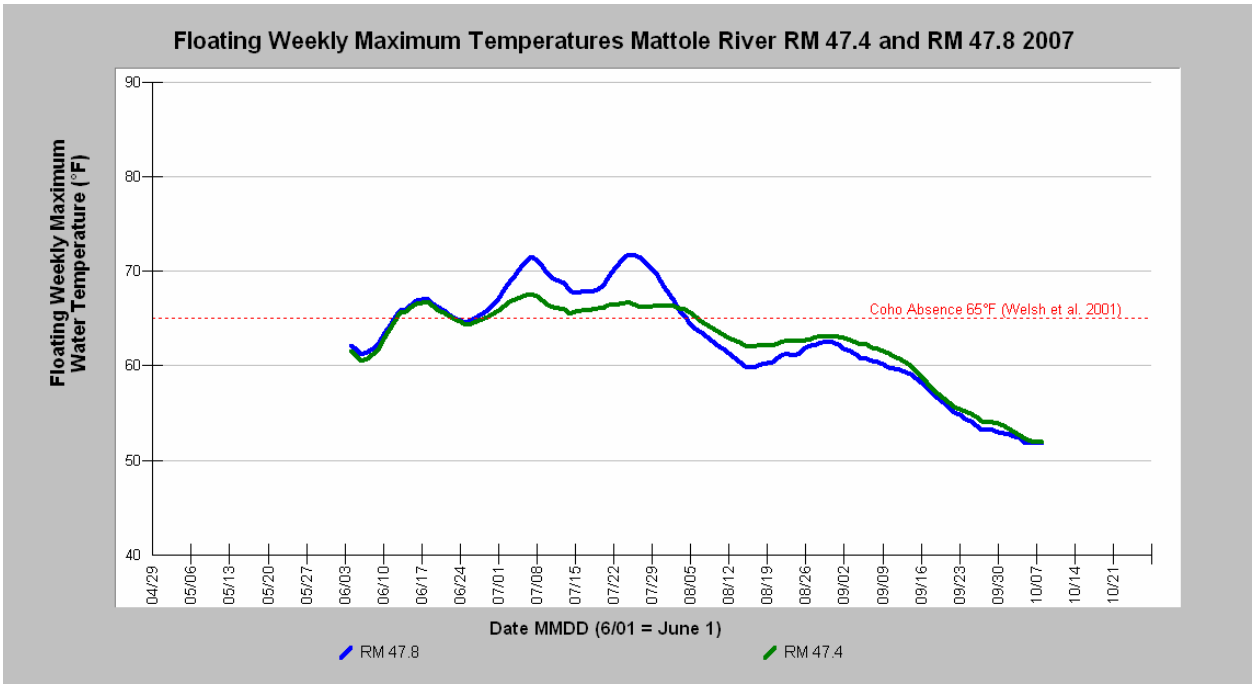


Figure 9. 2007 floating weekly maximum water temperatures in the Mattole upstream of Eubanks Creek (RM 47.8) and in the pool at Big Finley Creek (RM 47.4).

2007 maximum weekly average temperatures showed similar results. Four of the most upstream temperature monitoring locations, the Mattole headwaters (downstream of Ancestor Creek at RM 60.8, 56.57°F), MS-1 (RM 59.4, 60.14°F), MS-2 (RM 58.8, 61.00°F), and upstream of Thompson Creek (RM 58.6, 61.35°F) had suitable oversummering temperature for both juvenile coho (<63°F) and steelhead (<66.0°F), based on temperature tolerance criteria developed by Coates et al. 2002. MWATS recorded in the Mattole upstream of Baker Creek (RM 57.8, 63.2°F), at Metz Bridge (RM 56.9, 63.58°F), and upstream of Upper Mill Creek (RM 56.3, 63.26°F) were just slightly warmer than the coho threshold, but cool enough for steelhead. MS-5

(RM 53.8, 66.12°F), Junction Hole (RM 52.7, 66.00°F), and MS-6 exceeded favorable temperatures for both coho and steelhead (>66.0°F, Coates et al. 2002).

Maximum temperatures recorded at all sites upstream of RM 47.4 were below 75.0°F, the short-term lethal temperature for survival. Interestingly, during dive surveys of the upper mainstem in 2007, coho were only observed upstream of RM 54. Maximum temperatures were cooler at sites farther upstream For the most part, temperatures in the upper Mattole mainstem were favorable for salmonids. During the peak heat, temperatures exceeded thresholds for a short time period, but were usually favorable in most locations. Maximum temperatures greater than 68°F occurred for ~20 days at MS-5, MS-6, and Mattole upstream of Eubanks Creek. Temperatures at the Big Finley Creek pool were above 68°F, but only on 3 days of monitoring.

Snorkel surveys in the upper headwaters in summer 2007 confirmed the presence of coho in mainstem locations from RM 60.8 to RM 52.1, indicating the possibility that coho may be able to persist in a reach if floating weekly maximum temperatures do not exceed 65°F for a lengthy time period.

In comparison with 2006, 2007 temperatures were cooler. MWAT remained below 66.0°F at all monitoring sites upstream of Upper Mill Creek (RM 56.3) in 2007, and MWATs at all remaining sites in the southern subbasin (upstream of Bridge Creek at RM 52.1) were near 66.0°F. In 2006, some sites upstream of McKee Creek (RM 52.7) had MWATs as high as 69°F. In 2007, four temperature monitoring sites showed suitable MWATs for coho (<63.0°F, Coates et al. 2002); in comparison, no monitoring sites had a MWAT suitable for coho in 2006.

The upper Mattole provides the majority of thermally suitable mainstem oversummering habitat for juvenile salmonids. Temperatures in the upper river are significantly cooler than in the lower mainstem due to a variety of reasons including aggradation, insufficient habitat, and riparian dysfunction in the lower river. Salmonids in the upper Mattole were exposed to acute temperature stress in sites downstream of RM 54. Temperatures above or near juvenile salmonid MWAT and MWWT thresholds indicates oversummering salmonids in most areas of the upper mainstem experience stress due to chronic exposure to warmer than optimal rearing temperatures. Some locations in the upper mainstem, especially upstream of RM 54.0, showed suitable temperatures for juvenile survival and growth. Only the uppermost temperature monitoring locations were suitable for coho; more areas are thermally suitable for steelhead survival due to their greater temperature tolerance.

Despite favorable temperatures in the uppermost mainstem, issues with low-flow have depleted available habitat in the coolest areas of the mainstem. In recent years, many of the coolest areas of the upper mainstem have dried to a series of disconnected pools. Further effort is underway to monitor flow in addition to dissolved oxygen and other water quality parameters to further quantify risks to salmonids in these critical rearing reaches. See the MSG's 2007 Dissolved Oxygen Monitoring Report for further information.

<u>Lower and Middle Mainstem Mattole</u>

Fifteen sites in the Mattole were monitored to establish typical ambient water temperatures throughout the middle and lower mainstem. Sites were upstream of tributaries or in areas of

interest like the downstream migrant trap. In comparison to the upper mainstem, floating weekly maximum temperatures in the middle and lower mainstem were significantly higher. All sites in the mainstem downstream of RM 47.4 exceeded 65°F MWMT for the majority of the time period monitored, indicating lack of suitable coho habitat (See Figure 10-11).

2007 maximum weekly average temperatures (MWAT) in mainstem Mattole temperature monitoring sites downstream of river mile 47.4 also indicated lack of favorable oversummering habitat for juvenile salmonids. MWATs in fourteen of fifteen sites in the middle and lower mainstem exceeded threshold temperatures for both juvenile coho and steelhead presence (>63.0-66.0°F MWAT, Coates et al. 2002). MWMTs and MWATs above threshold temperatures suggest juvenile salmonids are unlikely to persist in the mainstem downstream of river mile 47.4 due to chronic temperature stress and indicate the importance of thermal refugia and tributaries for oversummering. Maximum weekly average temperatures in the lower and middle Mattole temperature monitoring sites ranged from 62.39°F (Mattole us Stansberry Creek (RM 1.3)) to 75.5°F (Mattole us Fourmile Creek, (RM 34.6)) in summer 2007.

Most MWATs in the middle and lower mainstem were between 72-75°F, well above suitable thresholds for salmonids. Temperatures upstream of Stansberry Creek (67.24°F maximum, 62.39°F MWAT) were notably cooler than other lower mainstem locations, due to the influence of inputs of cool water from this tributary, which was not far downstream. Another exception was the monitoring site upstream of Squaw Creek (69.07°F MWAT), located deep in a cold pool.

Maximum temperatures recorded in thirrteen of fifteen Mattole mainstem monitoring sites downstream of Big Finley Creek (RM 47.4) to Stansberry Creek (RM 1.3) exceeded 75.0°F, indicating acute temperature stress and possible lethal effects on salmonids (50% survival, Brungs and Jones 1977). The highest maximum temperature of any location was 83.15°F upstream of Clear Creek at RM 6.1. Sites where temperatures did not reach lethal levels were in the pool upstream of Squaw Creek (RM 15) and immediately upstream of Stansberry Creek (RM 1.3). Temperatures in middle to lower mainstem sites exceeded 68°F for a significant time period in summer 2007, thus salmonids were exposed to prolonged as well as acute temperature stress (See Table 1).

Ambient temperatures recorded suggest lack of suitable thermal habitat for all species of juvenile salmonids in the mainstem downstream Big Finley Creek (RM 47.4). Juvenile salmonids in the middle and lower river encounter acute as well as chronic temperature stress. Their long-term survival is threatened by exposure to lethal temperatures and/or decreased growth rates due to high metabolic demands at higher water temperatures.

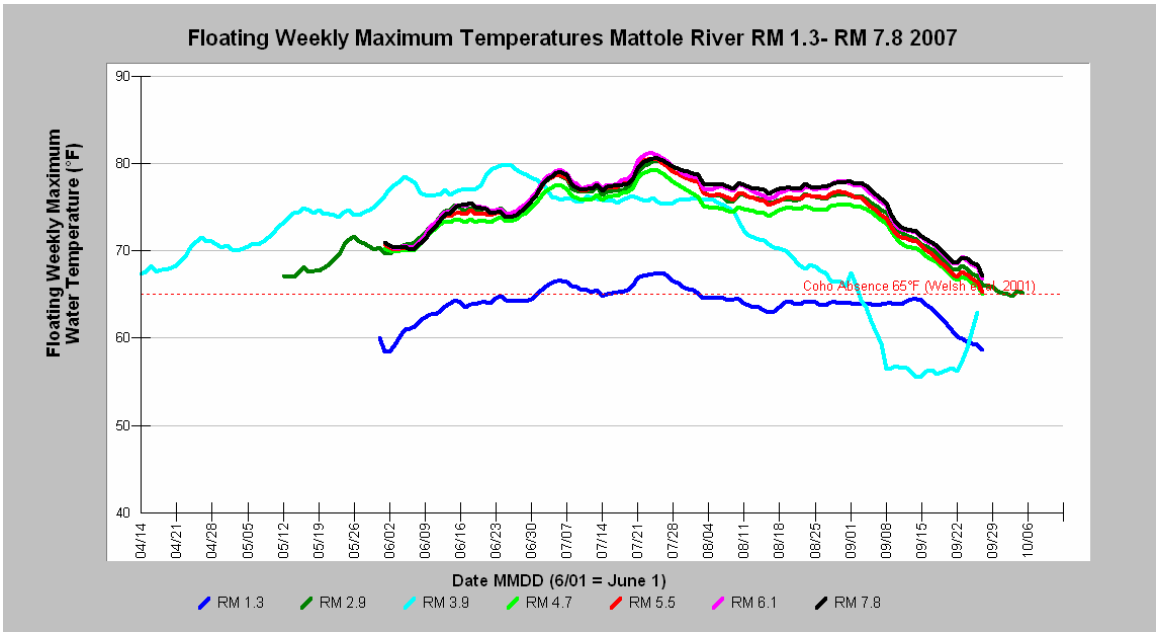


Figure 10. 2007 floating weekly maximum water temperatures at temperature monitoring locations in the Mattole mainstem, River Mile 1.3 to River Mile 7.8. Sites listed downstream (left) to upstream (right). See Table 1 for more information on locations.

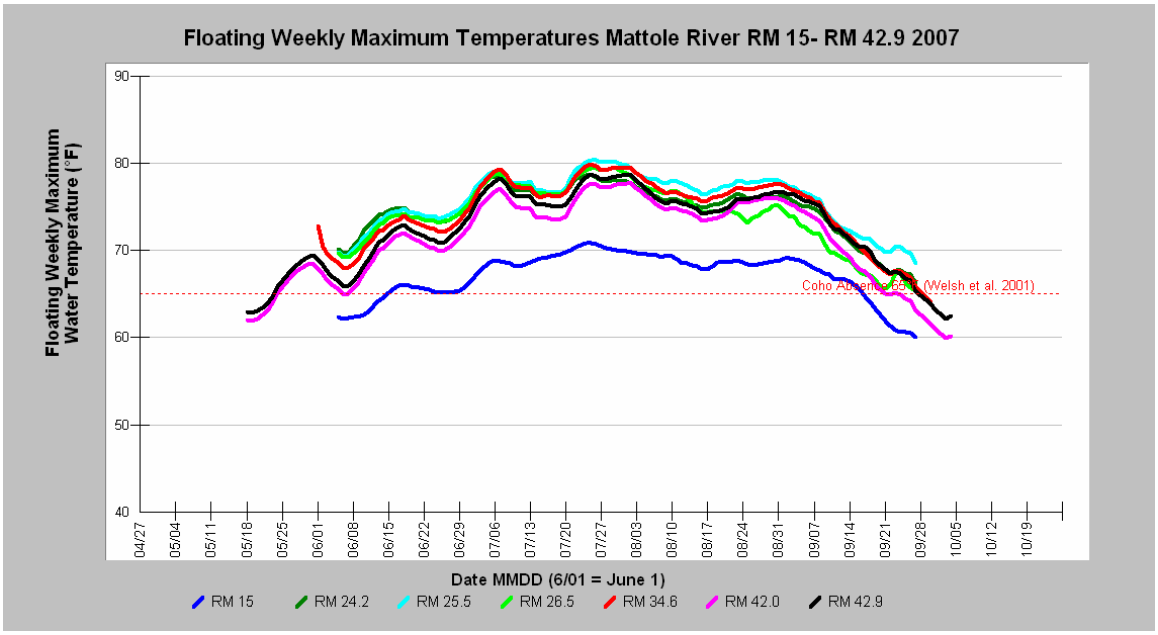


Figure 11. 2007 floating weekly maximum water temperatures at temperature monitoring locations in the Mattole mainstem, River Mile 15.0 to River Mile 42.9. Sites listed downstream (left) to upstream (right). See Table 1 for more information on locations.

2007 Temperature Monitoring results indicate the importance of thermal refugia such as cold pools, seeps, and cool-water tributaries for salmonids oversummering in the middle and lower mainstem. The only two lower/middle mainstem monitoring sites where maximum temperature did not exceed 75.0°F were located in cool refugia, one pool and directly upstream of one of the

coolest tributaries in the lower Mattole. Thermal refugia such as stratified pools, cold seeps or cool-water tributaries are essential for salmonid survival in the lower and middle Mattole over the summer months.

The Mattole Estuary

Historically, the Mattole estuary provided deep pools and favorable oversummering habitat for juvenile salmonids. Due to channel aggradation and almost complete absence of riparian cover, pools or any sort of favorable habitat or complexity, the estuary now represnts a "gauntlet" for migration to the ocean and is no longer viable oversummering habitat for Chinook salmon. MSG divers observe steelhead and Chinook, and usually small numbers of coho, in the estuary in the early summer every year. By late summer, few Chinook remain. In years when the mouth is open into mid-summer, most Chinook migrate to the Ocean, but when the mouth closes earlier in the summer, habitat is poor for survval. Data from the DSMT suggest when Chinook do migrating to the ocean prior to mouth closure, it is at a substandard size for ocean survival (MSG 2007, Reimers 1973). The state of the Mattole Estuary has been determined a major limiting factor to recovery of salmonid populations in the basin (MRC 1995).

Water temperature is perhaps one of the most important parameters to assess the suitability of the Mattole River lagoon for rearing salmonids. Water temperature influences juvenile salmonid growth, competition among species, and vulnerability to parasites, diseases and pollutants (Armour 1991). 2007 WAT temperature data recorded throughout the estuary suggest thermal conditions were sub-optimal for the positive growth and rearing of juvenile salmonids, especially following river mouth closure (See Figure 12). Although WAT indicated both the upper and lower estuary were not suitable for positive growth of juvenile salmonids, temperature data suggest that salmonid rearing conditions in the lower lagoon were likely better than in the upper portions of the lagoon.

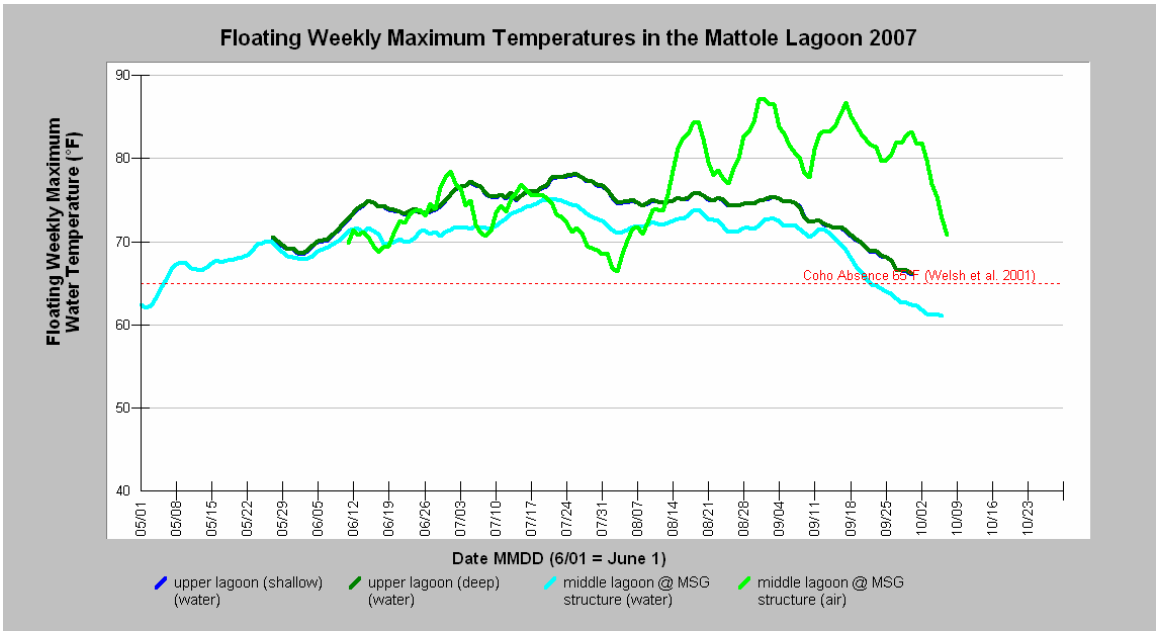


Figure 12. Floating Weekly Maximum Temperatures in the Mattole Estuary, 2007.

The MSG in cooperation with the USFWS initiated the first continuous multi-parameter water quality investigations using datasondes in the Mattole estuary in 2006. Concurrent dive monitoring monitored oversummer salmonid utilization of six different areas of the estuary. Because salmonids are exposed to all water quality parameters at once, effects may be cumulative. Additional factors include food availability and predation.

In the summer of 2007, a situation developed for which there was no documented precedent. An unseasonable rain approaching a magnitude of one inch fell throughout the watershed on July 18, 2007. On July 25, 2007, MSG divers noted an entirely unexpected phenomenon: over 17,000 juvenile Chinook were observed in the estuary. Prior to this date, MSG divers in the Mattole estuary had only been observing between 3,000 and 6,000 Chinook in the entire estuary during each survey. MSG believes the Chinook salmon juveniles that moved into the estuary had exited the headwater reaches where they had been holding, perhaps mobilized by impulses that anticipated a river mouth opening. Due to improperly functioning conditions in the estuary and the threat of competition for scarce resources, the MSG was immediately concerned about the possibility of a major decline in the newly enlarged juvenile Chinook population before the salvation of the seasonal mouth opening, not expected until late October.

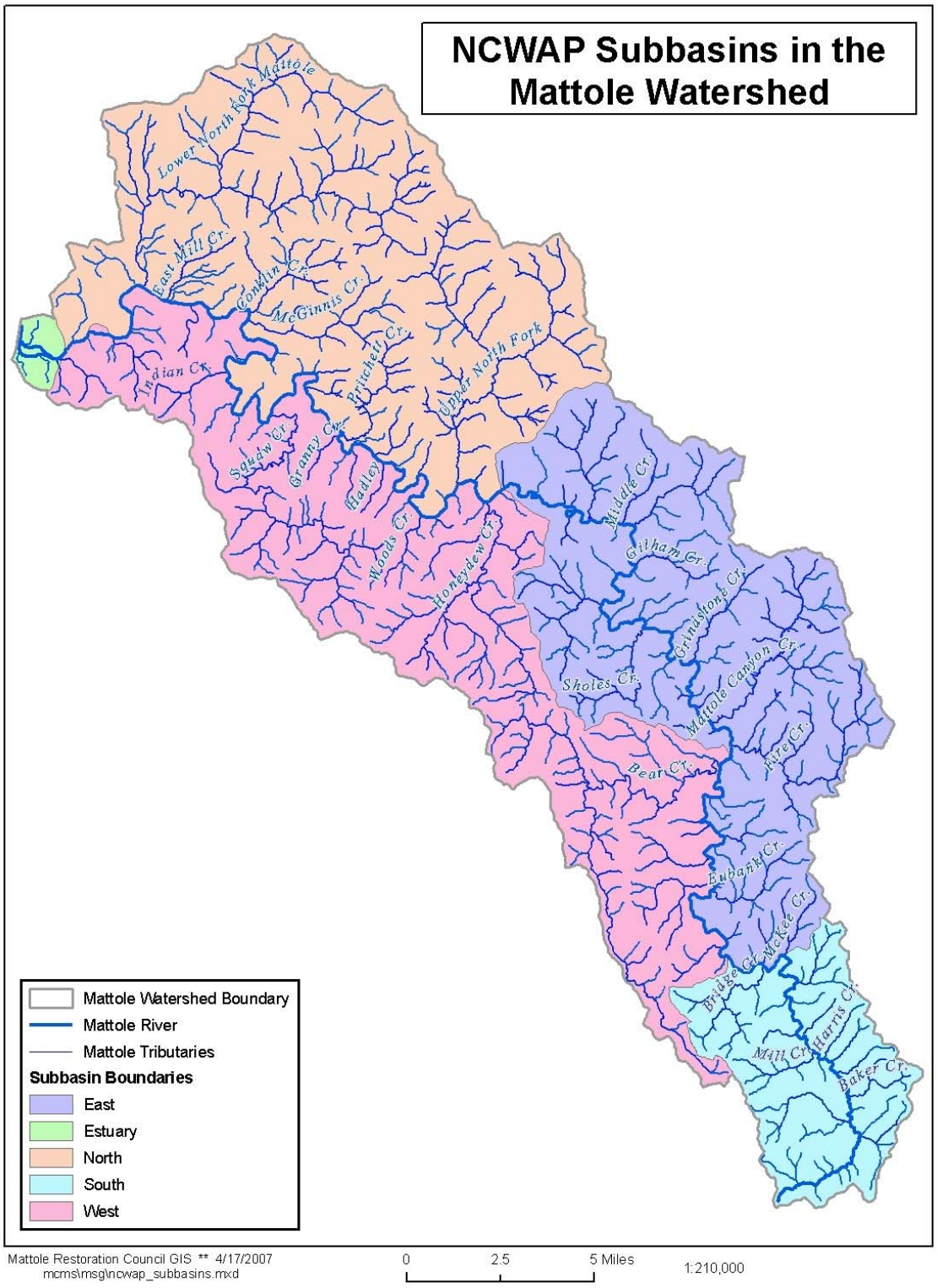
Further dive surveys confirmed a nearly a complete decline in observed Chinook. By the last dive (10/2) prior to mouth opening, only one Chinook was observed. Declines of salmonid populations in the estuary have been documented by MSG divers and HSU students in past years as well, but none were so well documented by frequent dive observation as the decline last summer. Future plans for further water quality investigations, habitat improvements, and mitigation for fish trapped in the estuary during substandard conditions are underway for the 2008 summer.

See the MSG's Estuary Water Quality Monitoring Report for further information.

Tributaries

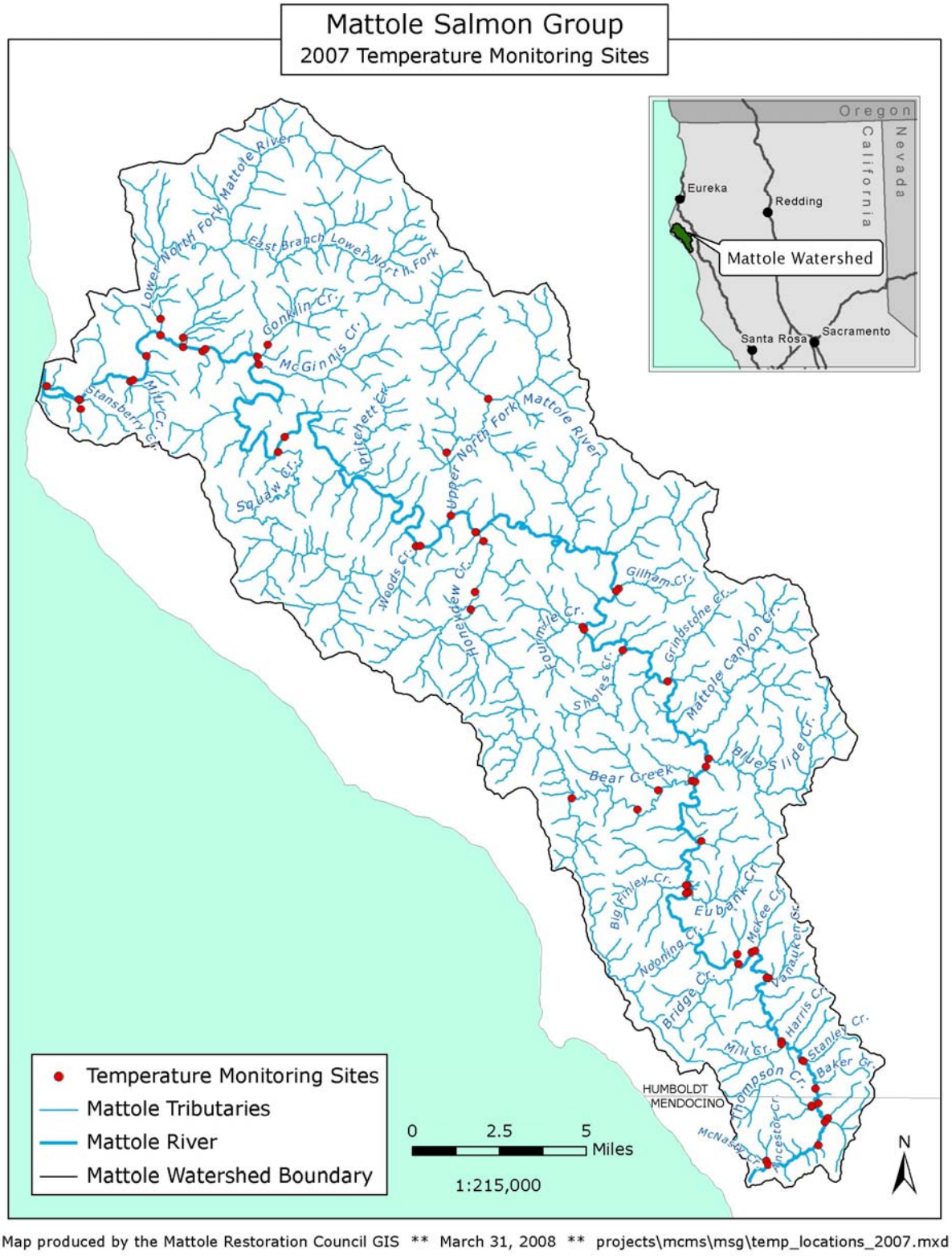
Tributaries are discussed by subbasin (See Figure 13). River Mile is also listed after each tributary. Please see map for further details (Figure 14).

Figure 13. Mattole Watershed Subbasins



Map courtesy Mattole Restoration Council GIS.

Figure 14. 2007 Mattole Watershed Temperature Monitoring Sites



Map: Mattole Restoration Council GIS.

Western Sub-basin

Lower Bear Creek (RM 1.0)

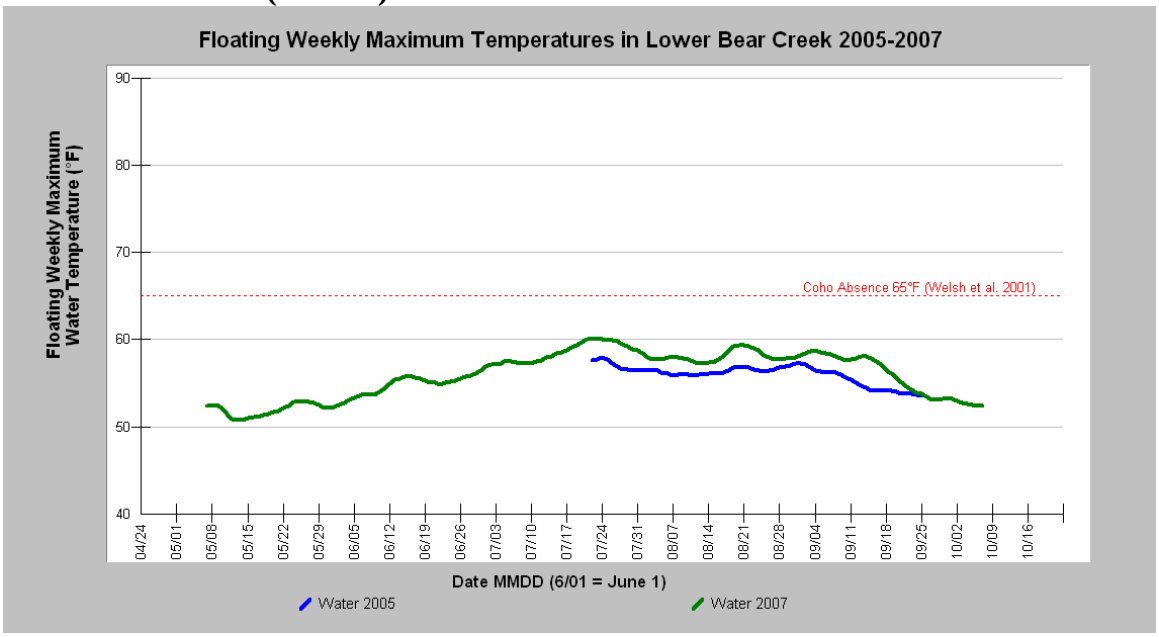


Figure 15. Floating Weekly Maximum Temperature in Lower Bear Creek, 2005 amd 2007.

Current monitoring of Lower Bear suggests temperatures remain cool throughout the summer in this tiny lower river creek. During 2005 and 2007, floating weekly maximum temperatures remained below the coho threshold (65°F MWMT, Wlesh et al. 2001). Access to cool-water tributaries is especially crucial in the lower Mattole where the mainstem reaches lethal temperatures. The cooling effect of inputs from these tributaries upon the mainstem is also important for salmonids oversummering in the lower river and just downstream in the estuary.

During dive surveys, only a very limited number of steelhead have ever been seen in Lower Bear Creek. These fish are likely residents of Lower Bear Creek as the creek is islated by the mainstem. Lower Bear was rerouted to accommodate Lighthouse Road many years ago, and does not currently meet the river. Several seeps form deep pools and a swamp on the northern side of Lighthouse Road where Lower Bear no longer flows thorugh its historical channel. The possibility of rerouting Lower Bear to its historic channel is being discussed to aid both hot temperatures in the lower river and to add more cool-water tributary habitat in this critical area.

Stansberry Creek (RM 1.3)

Temperature monitoring occurred in Stansberry Creek in 2006-2007. 2007 floating weekly maximum water temperatures in Stansberry Creek remained below 65°F on all days monitored except for one (MWMT on 9/03/07 was 65.05°F), indicating temperatures were mainly suitable for coho salmon rearing (Welsh et al. 2001) (See Figure 16). In 2006, floating weekly maximum water temperatures in Stansberry Creek were cooler than 65°F for the duration of monitoring.

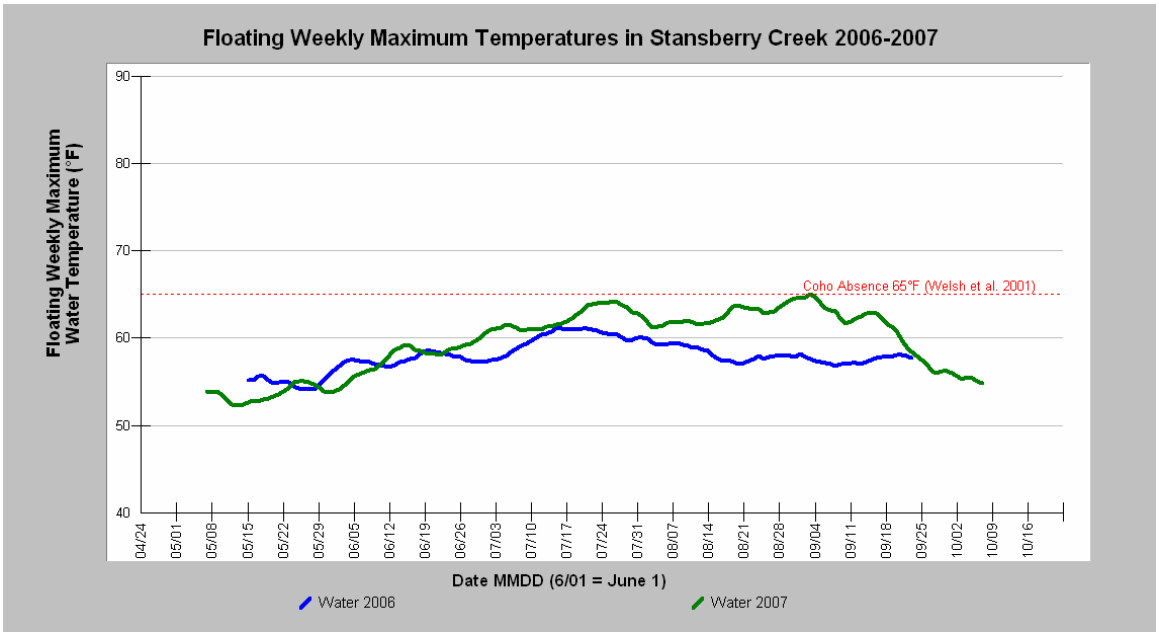


Figure 16. Floating Weekly Maximum Temperatures in Stansberry Creek, 2006-2007.

Maximum weekly average temperature (MWAT) indicated thermal habitat was suitable for juvenile coho but more favorable for steelhead. The 2007 MWAT was slightly higher (60.63°F), than the MWAT recorded in 2006 (58.86°F). Based on temperature tolerance criteria developed for the Mattole Watershed by Coates et al. (2002), Stansberry Creek provides "good" thermal habitat for steelhead (<63.0°F MWAT) and "marginal" habitat for coho (59.0-63.0°F MWAT). The maximum temperature recorded in 2007 was 67.24°F, below the threshold for prolonged thermal stress (68°F, Brett 1952). Of the lower river tributaries, Stansberry Creek provides one of the coolest habitats for salmonid oversummering.

Despite cool habitat, only steelhead were observed during 2006 and 2007 dive surveys. On 5/3/07, divers observed only one steelhead upstream of the snorkel reach. During the fall dive on 10/11/07, 17 (<4") steelhead and 12 (4"-8") steelhead were observed. The last 100' of Stansberry Creek was dry during the fall survey on 9/27/06; despite this, more steelhead were observed than in the spring (97 (<4") SH and 5 (4"-8") SH). Historical data also indicates only steelhead reside in Stansberry Creek.

Habitat improvements in lower Mattole tributaries with favorable summer temperatures are a restoration priority. Recently, approximately the last one hundred feet of Stansberry Creek upstream of the confluence were restored as part of a fish passage project. The streambed was re-routed and graded, a new culvert was installed, and willows and alders were planted in the riparian area.

During high flows, salmonid access to Stansberry Creek is unrestricted for all size-classes of salmonids. However, during low flows, a gap between the confluence and the new culvert presents a barrier to juveniles and is a candidate for a habitat improvement project. 2006-2007 temperatures indicate Stansberry Creek is a cool-water source for the Mattole mainstem and

thermally suitable as oversummering habitat. However, access issues impede unrestricted use of Stansberry Creek by juvenile salmonids.

Lower Mill Creek (RM 2.8)

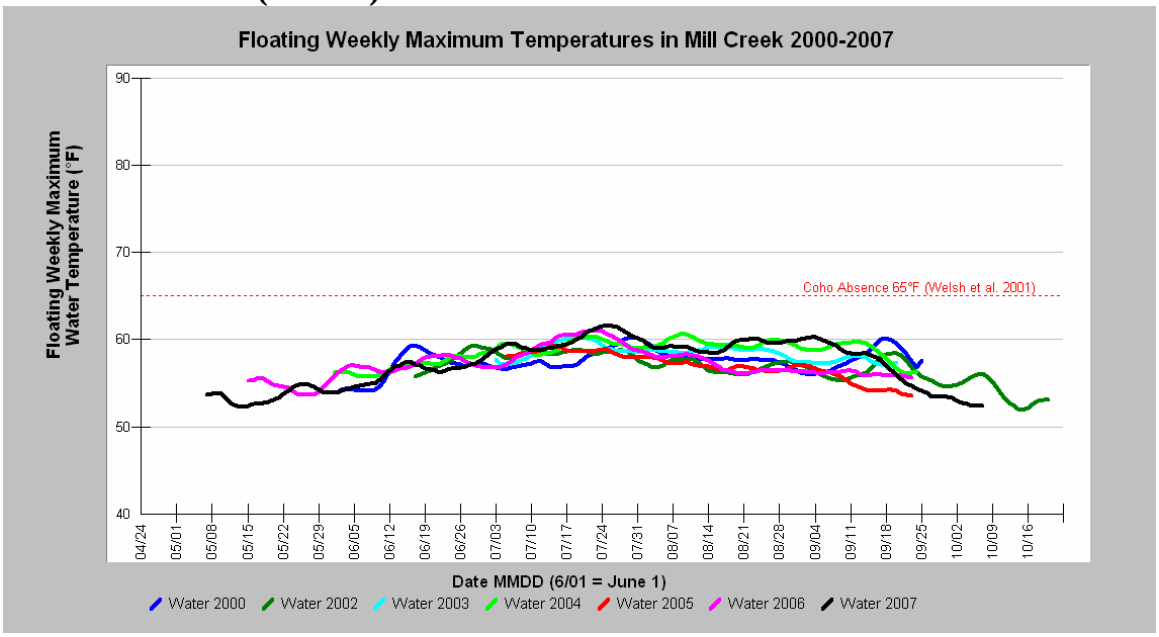


Figure 17. Floating Weekly Maximum Temperatures in Lower Mill Creek, 2000-2007.

The MSG has monitored temperature in Lower Mill Creek every year since 2000. Maximum floating weekly maximum water temperature (MWMT) remained cooler than 65°F, the coho threshold determined by Welsh et al. (2001), during all eight years monitored (See Figure 17). Maximum floating weekly average temperature (MWAT), another measure of chronic temperature stress, also indicated favorable thermal habitat for juvenile salmonids in Lower Mill Creek. The MWAT of 60.01°F recorded in 2007 was well below thresholds for both coho (<63.0°F) and steelhead (<66.0°F) (Coates et al. 2002).

Of the coho-bearing streams in the lower Mattole, Mill Creek is the coolest and contains arguably the best oversummering habitat for coho and steelhead. The maximum temperature recorded in lower Mill Creek in 2007 was 62.32°F, well below thresholds for prolonged stress of juvenile salmonids (68°F, Brett 1952).

A significant portion (222 acres, 17%) of the drainage remains old growth. The BLM owns 51% or 678 acres of the Mill Creek subshed. The Mill Creek Conservancy also acts to minimize impacts to the Mill Creek Forest and Lower Mill Creek, protecting valuable salmonid habitat and scarce old growth in the lower Mattole. Temperatures are cool enough to be suitable for coho salmon rearing, and lower Mill Creek maintains sufficient flow in the summer to provide habitat. The creek bed is also mainly cobble and gravel with little fine sediment in comparison to other lower Mattole tributaries.

A possible limiting factor to juvenile utilization of oversummering habitat in lower Mill Creek is an old sediment screen about a half mile up the creek. The structure was constructed in the

1980s to recruit spawning gravel for adult salmon in the lower reach of the creek. Prior to 2005, many redds were observed in the recruited gravels behind the lowest weir but the creek had down cut enough to leave two of the structures with passage issues. Boulder step pools were installed in summer of 2005 to mitigate this problem, allowing passage upstream for adult spawners.

While upstream-migrating adults are now able to access upper reaches of Lower Mill Creek at higher flows, the structure confines oversummering juveniles to the reach below the screens. Once juvenile salmonids have migrated downstream of the screen, they are no longer able to access the upper sections of the creek. Removal of the screen would provide unimpeded access to juvenile salmonids, allowing utilization of many more feet of cool-water coho habitat for oversummering juveniles seeking refuge from high summer temperatures in the lower mainstem.

Juvenile coho have been observed in Lower Mill Creek consistently during MSG dive surveys. In 2007, MSG divers observed four juvenile coho during the spring dive on 5/3. The MSG has also observed coho in lower Mill Creek during dive surveys in 2002-2004 and in 2006. One adult coho was also observed in the creek during a spawner survey. Steelhead have been observed in Lower Mill Creek during every dive survey on record.

Clear Creek (RM 6.1)

Clear Creek has been monitored for five years, from 2000-2002, and 2006-2007. All years indicated thermally suitable habitat for coho (<65°F MWMT, Welsh et al, 2001) (See Figure 18). Based on 2007 Maximum Weekly Average Temperature (60.59°F), thermal habitat in Clear Creek is good for steelhead (<63.0°F MWAT) and marginal for coho salmon (59.0-63.0°F MWAT) according to temperature tolerance criteria developed by Coates et al. (2002). In the lower Mattole, Clear Creek is among the coolest tributaries for salmonid oversummering. The maximum temperature recorded in 2007 was 63.09°F on 7/24/07.

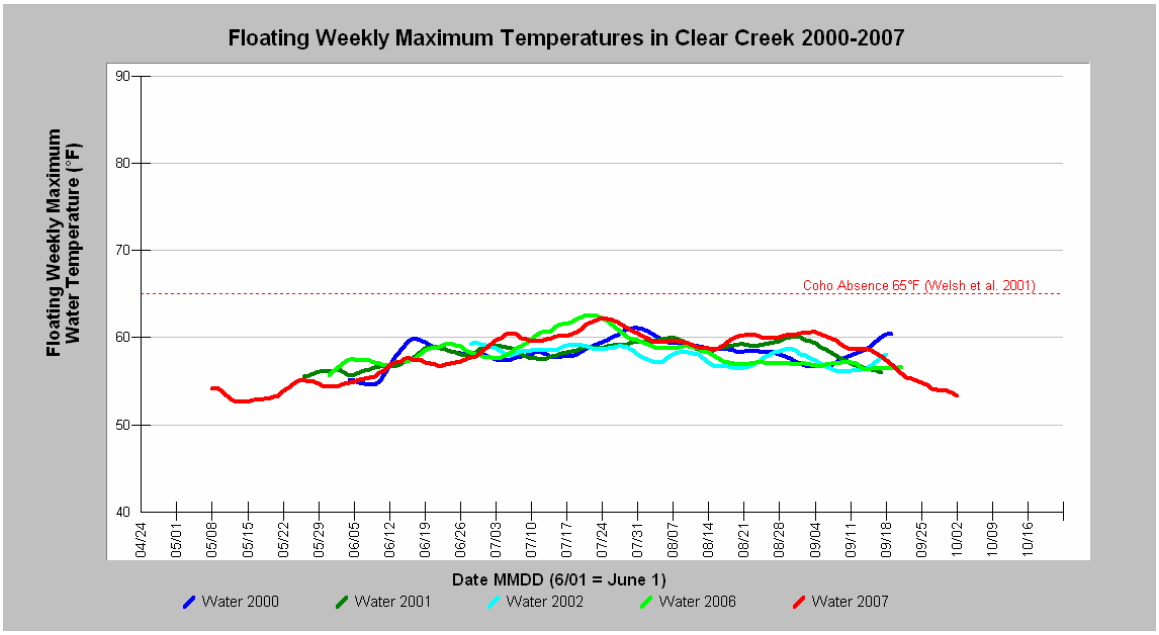


Figure 18. Floating Weekly Maximum Temperatures in Clear Creek, 2000-2007.

In 2006, divers have confirmed the presence of small numbers of coho in Clear Creek during spring dives. On 5/4/07, divers saw two salmonids that were possible coho, but were not able to make a positive id. Steelhead were observed in both spring and fall dives during all years surveyed. Dive surveys in 2001-2002 did not verify the presence of coho, although temperature monitoring indicated Clear Creek was thermally suitable for coho. Archival MSG survey data also confirms coho and steelhead presence. Clear Creek is a small creek, but it maintains enough flow to support salmonid habitation throughout the summer. Although no old-growth remains, only 4% of the drainage is grassland. Most of the subshed is mature forest, and Clear Creek is relatively shaded. Numerous larger rocks and large wood provide habitat and cover to oversummering salmonids. While temperature criteria characterize Clear Creek as marginal for coho, it provides more favorable coho habitat than most other creeks in the lower Mattole, especially when habitat characteristics in addition to temperature are considered.

Squaw Creek (RM 14.9)

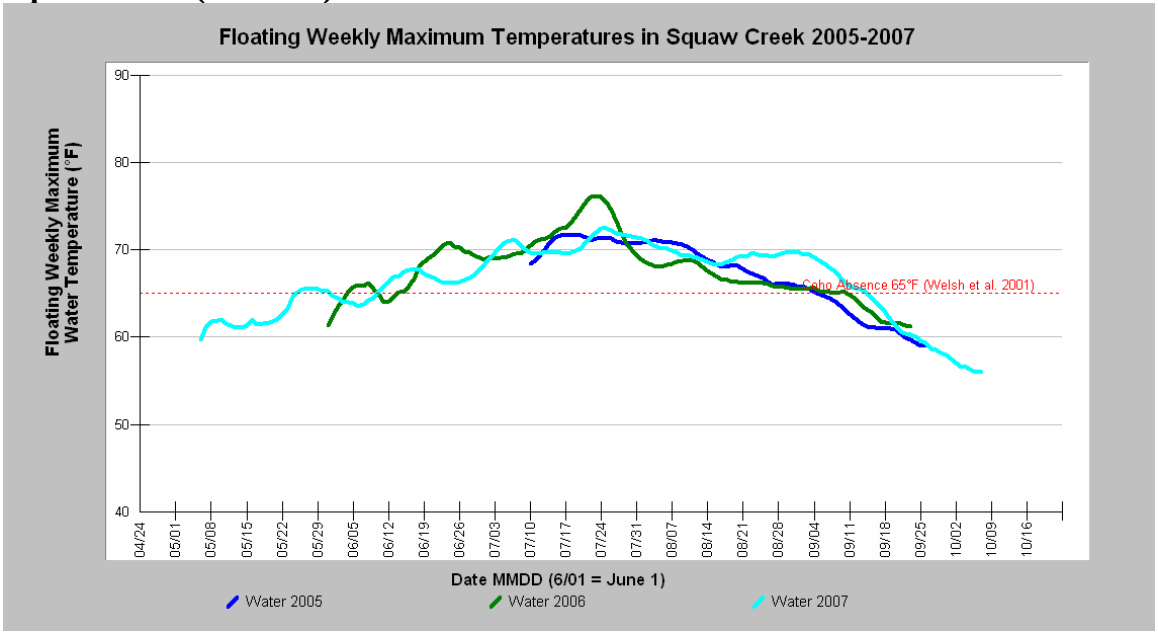


Figure 19. Floating Weekly Maximum Temperatures in Squaw Creek, 2005-2007.

Squaw Creek temperatures exceeded thresholds for juvenile salmonid oversummering in 2005-2007. Maximum floating weekly maximum water temperature (MWMT) exceeded 65°F during all three years, indicating temperatures were higher than suitable for coho salmon rearing (Welsh et al. 2001) (See Figure 19). Maximum weekly average temperatures also indicated temperatures were warmer than ideal for juvenile salmonids. In 2005 the MWAT in Squaw Creek was 66.92°F, exceeding thresholds for both coho and steelhead (<63.0-66.0°F MWAT, Coates et al. 2002). The 2006 MWAT in Squaw Creek (72.61°F) was significantly warmer than in 2005. In 2007, the MWAT was cooler (68.94°F), but still above thresholds for all Mattole salmonids.

The maximum temperature recorded in 2007 was 73.85°F, below the short-term maximum temperature threshold for salmonid survival (75.0°F, Brungs and Jones 1977). However,

maximum temperature exceeded 68°F on 65 of 161 days monitored in 2007, indicating prolonged temperature stress for salmonids oversummering in Squaw Creek (Brett 1952).

Squaw Creek is one of the larger lower river tributaries, and it has some favorable salmonid habitat attributes, including bedrock pools and riparian shading. Much of the drainage is forested with 11% remaining old growth; only 13% is grasslands. A sizeable amount (39%) of the subshed is owned by the BLM.

Despite temperatures above the coho threshold during the two years on record, coho and Chinook have been observed in Squaw Creek. During the spring dive on 6/11/06, both Chinook salmon (3) and coho (1) were observed. In 2007, there was no spring dive in Squaw Creek, and fifteen steelhead were observed on 10/11/06. MSG Pipe trap data from 2006 and prior years as well as past dive survey data have also confirmed the presence of coho, Chinook and steelhead in Squaw Creek.

During the late summer of 2006, a habitat improvement project occurred in the last 200 feet of Squaw Creek. Four structures consisting of large wood and boulder were constructed and anchored. The difference in steelhead utilization of Squaw Creek in spring before the structures were built and in fall after they were completed was substantial. While only 44 (<4") steelhead and 8 (4"-8") steelhead were observed in the spring, over a thousand <4" steelhead (1022), 5 (4"-8") steelhead, and 2 (>8") steelhead were observed on 9/27/06. No Chinook or coho were observed in fall 2006.

Woods Creek (RM 24.1)

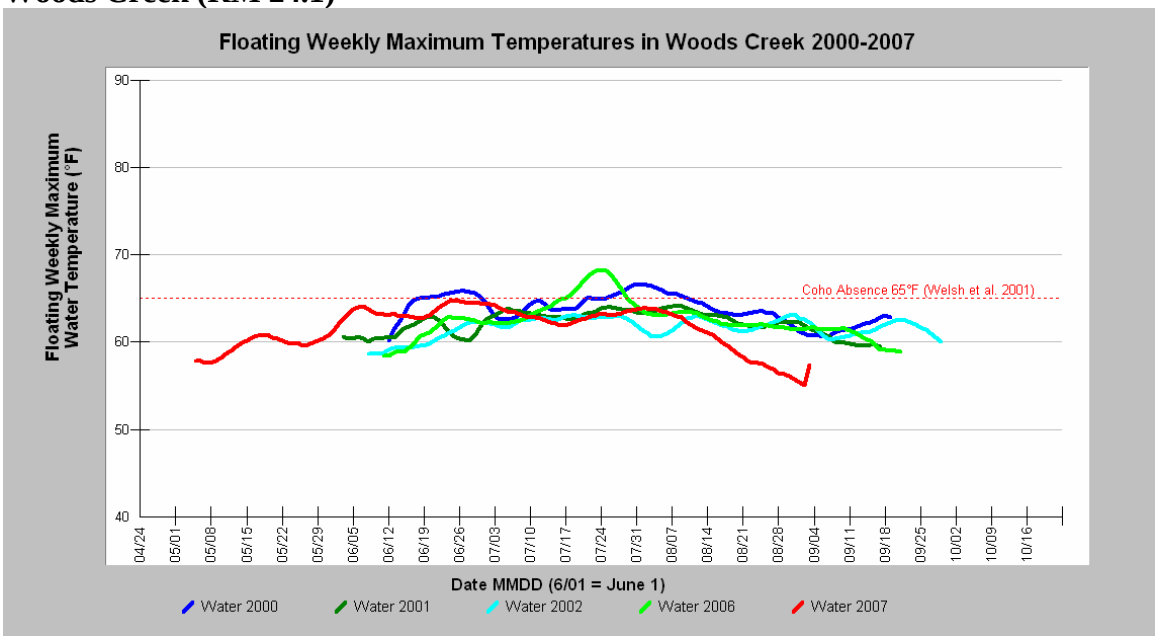


Figure 20. Floating Weekly Maximum Temperatures in Woods Creek, 2000-2007.

Temperature monitoring in Woods Creek occurred in 2000-2002 and in 2006-2007. In 2001, 2002, and 2007, maximum floating weekly maximum temperatures (MWMT) remained below the coho threshold (See Figure 20); however, MWMT exceeded 65°F in 2000 and 2006.

Results indicate temperatures are higher than suitable for coho salmon rearing during warmer years (Welsh et al. 2001). Woods Creek may provide suitable coho oversummering habitat during cooler years and outside of the period of peak summer temperature. 2000 and 2006 temperatures exceeded the coho threshold for only a short period during peak temperatures in mid-July. 2007 MWAT (61.65°F) indicated thermal habitat in Woods Creek was "marginal" for coho (59.0-63.0°F) but suitable for steelhead (>66.0°F) (Coates et al. 2002). The maximum temperature reached in Woods Creek in 2007 was 65.73°F on June 23, well below the short-term lethal temperature for salmonids (75.0°F, Brungs and Jones 1977). Maximum temperatures in Woods Creek did not exceed 68°F, indicating salmonids were not exposed to prolonged thermal stress (Brett 1952).

In addition to relatively cool summer temperatures, the lower reach of Woods Creek appears to have other attributes of favorable salmonid habitat, including cobble and gravel with lack of significant amounts of fine sediment as well as riparian shading and rootwads for cover. The subshed is mainly forested, with 0% grassland and 3% old growth. 76% of the drainage is owned by the BLM.

MSG dive surveys confirm coho presence in Woods Creek. In 2007, MSG divers found coho in Woods Creek during both the spring (3) and fall (2) dives. Small numbers of coho young-of-the-year were also observed during the spring dive in 2006 (8) and the fall dive 2001 (2). It is unknown if coho found in Woods Creek came from coho spawning in the creek or if juvenile coho seeking refuge from the warm temperatures prevalent in the lower mainstem Mattole oversummer in Woods Creek.

Dive surveys also indicate steelhead presence in Woods Creek. MSG divers have identified steelhead during spring and fall juvenile dive surveys in 2001-2002 and 2006-2007. The greatest number of steelhead observed in Woods Creek was in 2006.

Honeydew Creek (RM 26.5)

Honeydew Creek was monitored in 2006-2007 for the first time since before 2000. In 2007, temperature loggers were deployed at three monitoring locations in the Honeydew Creek subshed. Upper and lower reaches and the east fork of Honeydew Creek were selected for temperature and dive monitoring.

Maximum floating weekly maximum water temperature (MWMT) exceeded 65°F in all three locations, indicating temperatures in Honeydew Creek were higher than suitable for coho salmon rearing (Welsh et al. 2001) (See Figure 21). MWAT thresholds showed mixed results. The MWAT in the east fork of Honeydew Creek was noticeably warmer than MWATs in the upper and lower reaches. In east fork Honeydew Creek, MWAT (67.62°F) was warmer than ideal for both coho (<63.0°F) and steelhead (<66.0°F), while MWAT in lower Honeydew Creek (65.45°F) was cool enough to support steelhead. Only upper Honeydew Creek had an MWAT suitable for coho (62.85°F). The 2007 upper Honeydew Creek monitoring location was ~2.5 miles upstream of the 2006 upper Honeydew Creek location. 2007 temperatures were several degrees lower than those recorded in 2006 at the upper Honeydew Creek location, reflecting this difference.

Maximum temperatures in lower Honeydew reached 72.81°F, while maximum temperature in east fork Honeydew Creek (68.74°F) and upper Honeydew (67.11°F) were several degrees cooler. Temperatures in Honeydew Creek did not reach acute lethal levels, but did show prolonged temperature stress in the lower site (>68°F on 64 of 126 days). Temperatures in east fork Honeydew surpassed 68°F on 4 of 106 days. Of the three sites, the upper Honeydew Creek location had the most favorable thermal habitat, and the two upstream locations were notably cooler than the lower Honeydew site.

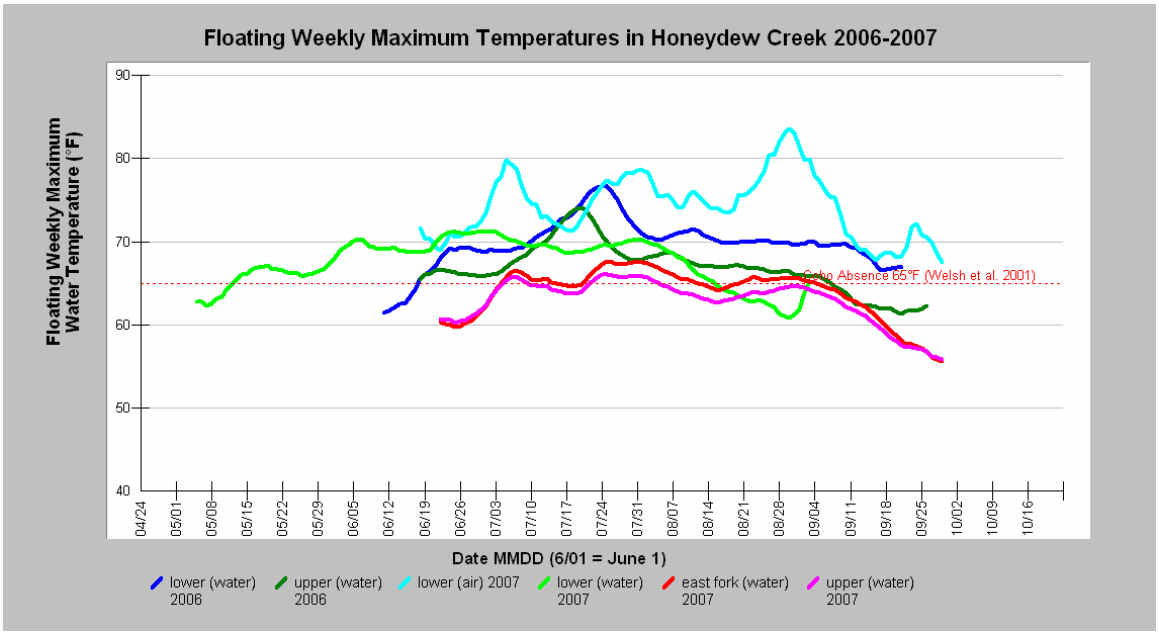


Figure 21. Floating Weekly Maximum Temperatures in Honeydew Creek 2006-2007.

Salmonid counts in Honeydew Creek also differed significantly between lower Honeydew and the two upper reaches. In spring, hundreds of steelhead were observed in upper Honeydew (207 (<4") steelhead, 3 (4"-8") steelhead, 1 (>8") steelhead) and east fork Honeydew (278 (<4") steelhead, 6 (4"-8") steelhead), while no fish were observed in lower Honeydew. In the fall, only 30 steelhead young-of-the-year were seen in upper Honeydew and 3 in the east fork. In lower Honeydew, steelhead were much more numerous in the fall (329 (<4"), 43 (4"-8"), 9 (>8")). The difference may be due to migration patterns; steelhead oversummering in the upper reaches may have emigrated downstream by the fall.

Although recent surveys have identified only steelhead, past survey data indicates steelhead, Chinook, and coho utilize Honeydew Creek. Honeydew Creek is impacted by slides and sedimentation, but deep pools and refuges do exist. It is also notable that 22% (448 acres) of the Honeydew Creek drainage remains old growth and 71% (7,786 acres) of the subshed is owned by the BLM. Due the large proportion of its watershed in the King Range National Conservation Area, Honeydew Creek is one of the least impacted of Mattole tributaries by human land practices.

Fourmile Creek (RM 34.6)

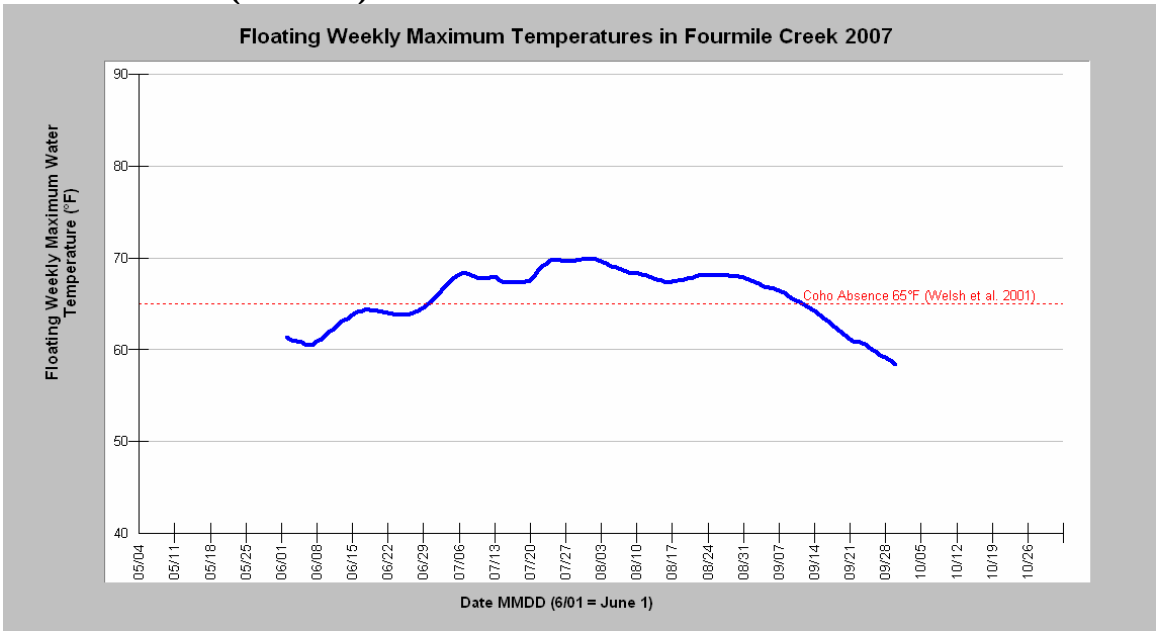


Figure 22. Floating Weekly Maximum Temperatures in Fourmile Creek, 2007.

Fourmile Creek was monitored for temperature and juvenile salmonid presence for the first time in 2007. Floating Weekly Maximum Temperatures surpassed 65°F, showing thermal habitat was warmer than ideal for coho inhabitation (Welsh et al. 2001) (See Figure 22). The 2007 MWAT recorded in Fourmile Creek was 65.08°F. According to Coates et al. 2002, this MWAT indicates poor thermal habitat for coho (>63°F) as well as steelhead (>66°F).

Maximum temperatures recorded in Fourmile Creek in 2007 verified salmonids here were exposed to chronic temperatures stress (Brett 1952). Temperatures above 68°F were recorded on 39 of 127 days of monitoring. The maximum temperature reached in Fourmile Creek was 70.54°F, below the short-term maximum temperature (75°F) which would indicate acute thermal stress (brings and Jones 1977).

Historically coho and steelhead have been found in Fourmile Creek. Both species were observed during 2007 dive surveys. Coho (3) were observed in the fall but not in the spring. Many more steelhead were observed in the fall (455 yoy and 68 (4”-8”) steelhead) than in the spring (197 yoy and 7 (4”-8”) steelhead)

Sholes Creek (RM 36.6)

2007 was the first year of MSG temperature monitoring in Sholes Creek. Floating Weekly Maximum Temperatures recorded in Sholes Creek showed suitable thermal habitat for coho (below 65°F MWMT, Welsh et al. 2001) (See Figure 23). The maximum weekly average temperature in Sholes Creek was 62.38°F, indicating good habitat for steelhead (<63°F) and marginal habitat for coho (59-63°F, Coates et al. 2002). Maximum temperatures did not suggest prolonged or acute thermal stress for juvenile salmonids.

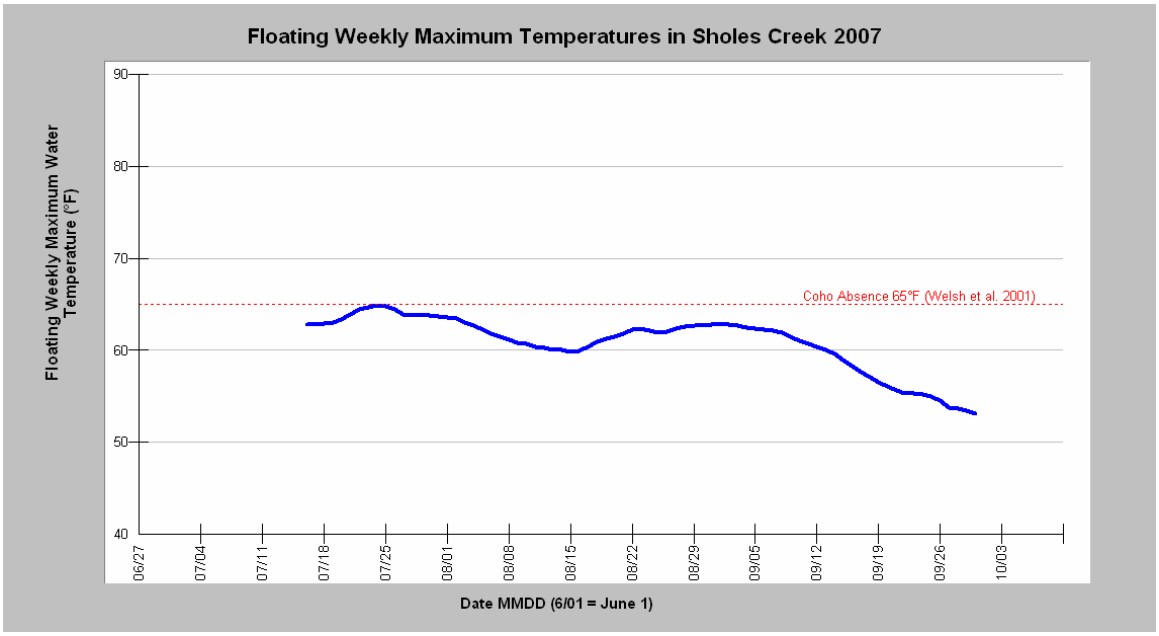


Figure 23. Floating Weekly Maximum Temperatures in Sholes Creek 2007.

2007 dive surveys in Sholes Creek identified only steelhead. 288 steelhead yoy and 1 (4"-8") steelhead were found in the spring, and 95 steelhead yoy and 4 (4"-8") steelhead were observed in the fall. Historical salmonid species presence included coho salmon and steelhead.

The Sholes Creek drainage is mainly forested, with about 3% grasslands and 5% remaining old growth. The subshed is characterized by relatively large property ownerships; some land (12%) is under the management of the BLM. Sholes Creek enters the middle Mattole where mainstem temperatures are often warm enough to be lethal to all species of salmonids. There are deep pools and some cover present in this remote area. As a cool-water tributary in the middle Mattole, Sholes Creek is important for salmonid habitat, both as a refuge and as a source of cooler water inputs for the mainstem.

Bear Creek (RM 42.8), South Fork Bear Creek and Jewett Creek

In 2007, there were four temperature monitoring locations in the Bear Creek subshed. The lower Bear Creek monitoring location (RM 42.8 + ~0.2) was the warmest. Temperatures in the upper (RM 42.8 +~3.1) and lower mainstem of Bear Creek exceeded the threshold for coho (65°F MWMT, Welsh et al. 2001). Temperatures in two Bear Creek tributaries, South Fork Bear Creek (RM 42.8 + ~6.0) and Jewett Creek (RM 42.8 +~3+0.1) were noticeably cooler and remained suitable for coho throughout the summer of 2007.

Historical dive and downstream migrant trapping data indicate coho, Chinook, and steelhead reside in Bear Creek. In 2007, the MSG dove in lower Bear Creek, South Fork Bear Creek, and Jewett Creek. Chinook and steelhead were observed in all three locations during the spring dives. During fall dives, divers saw only steelhead. No coho were observed in the Bear Creek subshed in 2007. Lower Bear Creek had the greatest observed salmonid presence. Ninety-eight Chinook and 1133 steelhead young of the year were observed in the spring; in the fall, surveyors found 149 steelhead young-of-the-year, 79 (4"-8") steelhead, and 2 (>8) steelhead. More

steelhead were observed in Jewett Creek than South Fork Bear Creek during both spring and fall dives. One Chinook was observed in each of the Bear Creek tributaries in the spring.

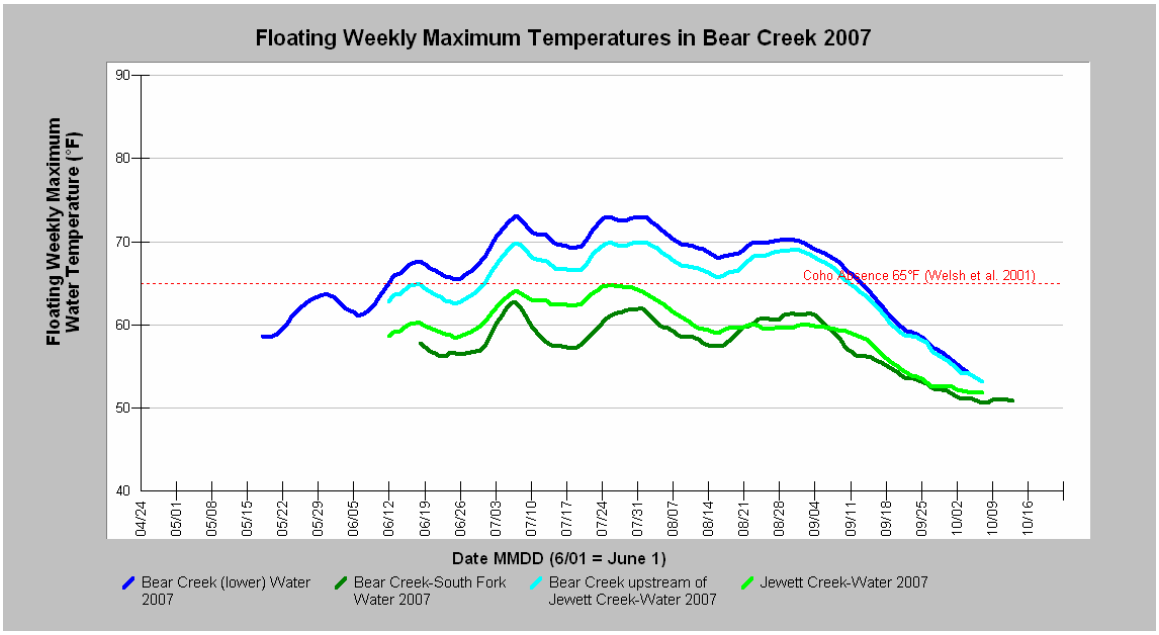


Figure 24. Floating Weekly Maximum Temperatures in Bear Creek, South Fork Bear Creek, and Jewett Creek in 2007.

Bear Creek is the largest tributary in the Mattole aside from the Upper and Lower North Forks. A large proportion of this subshed exists as part of the King Range Conservation Area. In tributaries and the upper section of the tributary, there is little human impact and nearly pristine habitat features. Increased temperature and dive monitoring of the upper Bear Creek subshed would expand our knowledge of salmonid distribution in this favorable habitat area of the Mattole.

Big Finley Creek (RM 47.4)

The MSG conducted temperature monitoring in Big Finley Creek for the first time in 2007. Maximum floating weekly maximum water temperature (MWMT) showed suitable thermal habitat for coho rearing (<65°F, Welsh et al. 2001). The MWAT (59.8°F) also indicated Big Finley Creek was favorable for coho (<63°F) as well as steelhead (<66°F, Coates et al. 2002). The maximum temperature recorded in 2007 was a cool 62.36°F, demonstrating lack of thermal stress to salmonids rearing here.

Big Finley Creek comes into the Mattole in a very remote area and provides excellent salmonid oversummering habitat. Much of the subshed (84%) is managed by the BLM. It is a larger drainage in comparison with other tributaries in the upper/middle Mattole. In contrast to other streams in the upper Mattole, there are few roads and little water diversion for human use, contributing to little fine sediment, deep pools, and significant summer flows. Additionally, much of the subshed is forested, and 19% remains old growth.

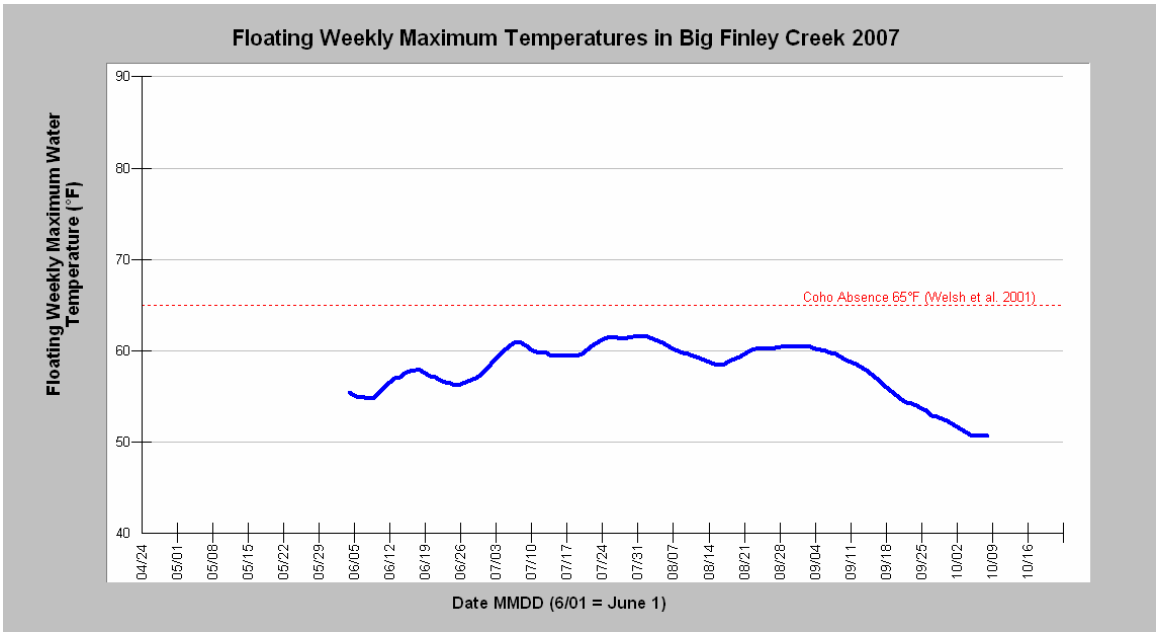


Figure 25. Floating Weekly Maximum Temperatures in Big Finley Creek in 2007.

Historically, coho and steelhead were known to utilize Big Finley Creek. In 2007, MSG divers observed Chinook and steelhead, but no coho. Chinook (7) were observed in the spring. Larger size class steelhead were observed in More steelhead were observed in the spring (79 young-of-the-year, 21 (4"-8"), 2 (>8")) than in the fall (37 young-of-the-year, 6 (4"-8"), 1 (>8")).

Northern Sub-basin

East Mill Creek (RM 5.4)

The MSG has monitored temperatures in East Mill Creek every year since 2003. For the most part, temperatures in East Mill Creek have been suitable for coho salmon rearing. Floating weekly maximum water temperature slightly exceeded 65°F in 2003 and 2004 during peak heat, indicating temperatures were warmer than suitable for coho for only a short time (Welsh et al. 2001) (See Figure 26). In 2005-2007, temperatures remained just below the coho threshold. The maximum weekly average temperature in East Mill Creek was 62.26°F in 2007, indicating thermal habitat was marginal for coho (59.0-63.0°F) but good for steelhead (<63.0°F) (Coates et al. 2002). Maximum temperature (65.32°F) recorded in East Mill Creek was well below lethal temperatures for salmonids and did not suggest prolonged thermal stress.

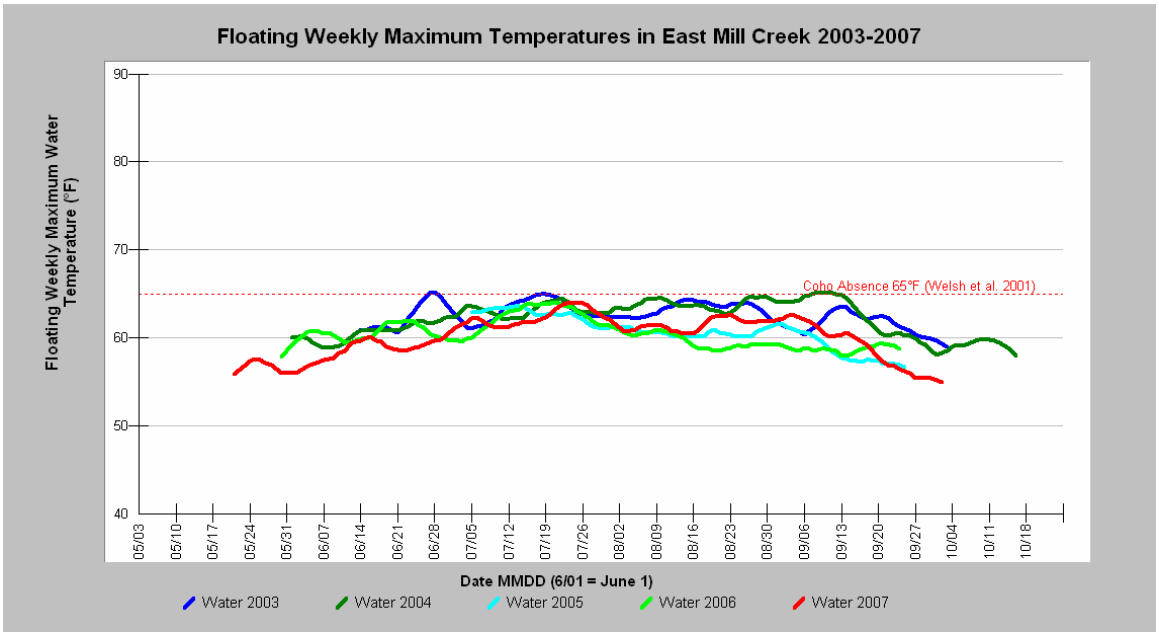


Figure 26. Floating Weekly Maximum Temperatures in East Mill Creek, 2003-2007.

Coho salmon have been documented in East Mill Creek during spring dives in 2003, 2004, and 2006. There were no dives in East Mill in 2005, and only steelhead were observed in 2007. Consistent observations of less than ten coho indicate East Mill Creek supports a very small population of coho juveniles in some years. It is unknown if these juveniles come from spawners in East Mill Creek or are coho from the Mattole mainstem seeking refuge in the cool temperatures and relatively good fish habitat found in East Mill Creek in comparison to the lower mainstem Mattole. Juvenile steelhead presence in East Mill Creek has also been documented by MSG snorkel surveys.

Despite a significant percentage of grasslands (29%) and many residents settled along the creek, East Mill Creek remains one of the coolest lower river tributaries. Consistent observation of juvenile salmonids in addition to cold temperatures indicate East Mill Creek offers a cool refuge and is valuable oversummering habitat in the lower Mattole. A barrier removal project is scheduled in 2008 to make more of East Mill Creek accessible to coho and steelhead.

Conklin Creek (RM 7.8)

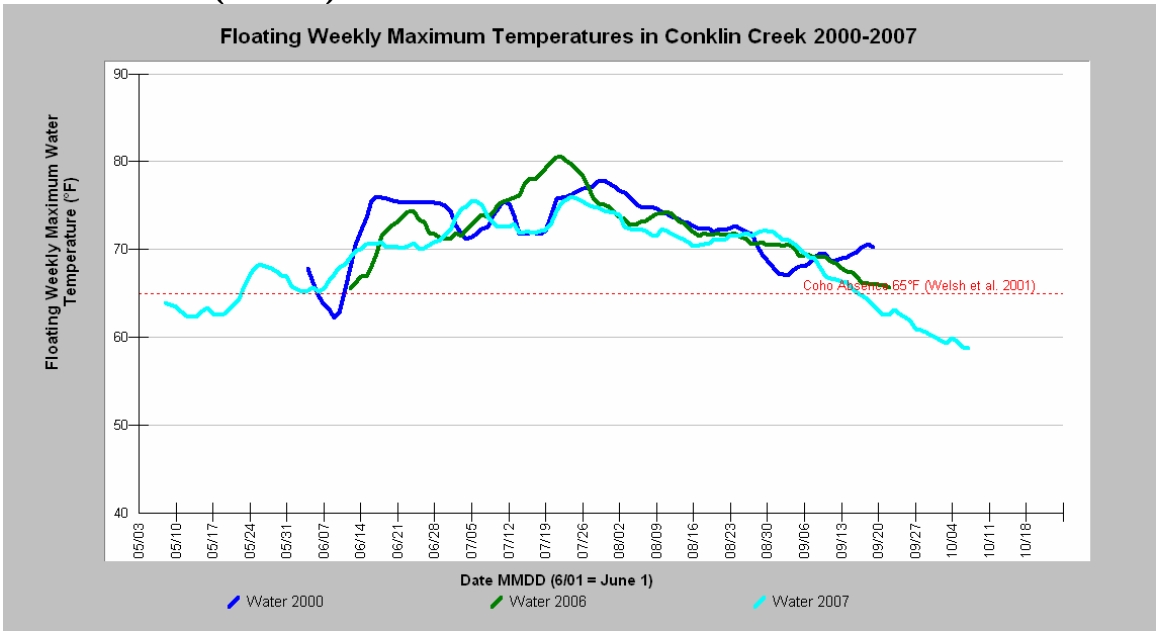


Figure 27. Floating Weekly Maximum Temperatures in Conklin Creek, 2000-2007.

Maximum floating weekly maximum water temperature (MWMT) exceeded 65°F in 2000, 2006, and 2007, indicating temperatures were not suitable for coho salmon rearing (Welsh et al. 2001) (See Figure 27). In 2007, the MWAT recorded in Conklin Creek was 65.89°F. According to Coates et al. 2002, this MWAT exceeded threshold temperatures for coho (<63.0°F) but remained cool enough for steelhead (<66.0°F). The maximum temperature recorded in Conklin Creek was 77.95°F, above short-term maximum lethal temperature (>75.0°F) for juvenile salmonids (Brungs and Jones 1977). Salmonids oversummering in Conklin Creek were exposed to prolonged as well as acute temperature stress. Maximum temperatures were warmer than 68°F during 89 of 159 days monitored.

Divers from the Mattole Salmon Group have not observed either coho or Chinook salmon in Conklin Creek despite multiple years of juvenile dive surveys. However, juvenile steelhead presence has been documented by MSG divers and historical accounts by longtime residents. Two large slides occurred in the Conklin Creek subshed during the storms of winter 2005, creating massive sediment accumulation in Conklin Creek. This disturbance drastically degraded fish habitat in the creek, filling in pool habitat and causing most of Conklin Creek's flow to go subsurface. In 2007, MSG divers saw steelhead only in the fall; 94 steelhead young-of-the-year and 15 (4”-8”) steelhead were observed in ten pools upstream of Conklin Creek's confluence with the Mattole.

Upper North Fork (RM 25.5) and Oil Creek

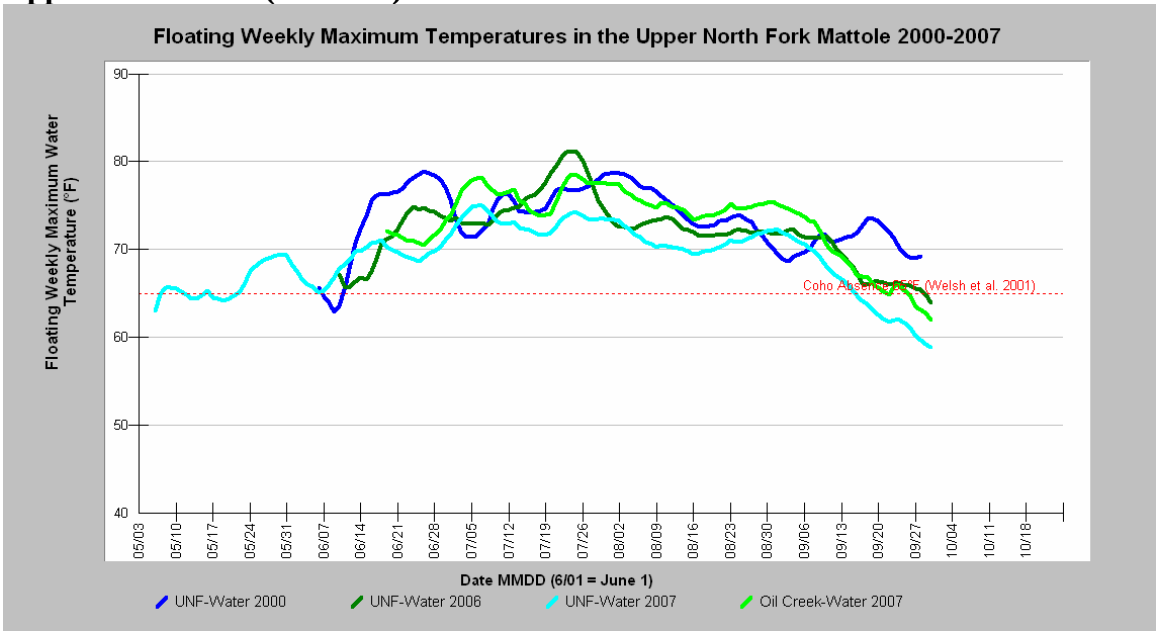


Figure 28. Floating Weekly Maximum Temperatures in the Upper North Fork Mattole and Oil Creek, 2000-2007.

Maximum floating weekly maximum water temperature (MWMT) exceeded 65°F in 2000, 2006, and 2007 indicating temperatures were not suitable for coho salmon rearing (Welsh et al. 2001) (See Figure 28). 2007 MWAT in the Upper North Fork was 69.3°F, also suggesting temperatures were unsuitable for coho (>63.0°F) as well as steelhead (>66.0°F). Salmonids oversummering in the Upper North Fork were subject to prolonged temperature stress for the majority of the summer. Temperatures in the Upper North Fork exceeded 68°F on 105 of 154 days monitored. The maximum temperature in the Upper North Fork was 77.14°F, well above short-term lethal temperature for juvenile salmonids (75.0°F, Brungs and Jones 1977) and comparable to mainstem maximum temperatures in many locations.

The Upper North Fork Mattole is a large subshed relative to other tributaries to the Mattole (16,696 acres). Much of the Upper North Fork Mattole is very remote and there are few road access points. Most of the subshed was previously logged; now 2% old growth remains and 20% of the drainage is grassland. A small percentage (1%) of the drainage is owned by the BLM. Numerous slides in tributaries to the Upper North Fork and the Upper North Fork itself contribute sediment, and a layer of fine sediment is noticeable in some pools and near its confluence with the mainstem Mattole. The channel is highly aggraded in most areas, but steep bedrock canyon walls and mature forest shade some locales.

Past survey data from the Upper North Fork indicates Chinook and steelhead presence. Longtime residents report observations of salmon spawning in the Upper North in the early 1980s. During the 2007 snorkel surveys, divers observed 5 steelhead young-of-the-year during the fall dive on 10/4; none were observed in the spring.

In 2007, the MSG also monitored temperature in Oil Creek, a tributary to the Upper North Fork. Temperatures recorded in Oil Creek were even warmer than in the Upper North Fork. Floating Weekly Maximum Temperatures indicated lack of suitable thermal habitat for coho (Welsh et al. 2001). The MWAT in Oil Creek (68.97°F) also showed poor thermal habitat for both coho and steelhead (Coates et al. 2002). Maximum temperatures showed salmonids in Oil Creek were subject to acute and prolonged thermal stress. The maximum temperature reached in Oil Creek was 79.83°F, and temperatures exceeded 68°F on 91 of 110 days of monitoring. Despite this, greater numbers of steelhead were observed in Oil Creek than in the Upper North Fork salmonids (161 young-of-the-year and 23 (4"-8") steelhead in the spring and 93 young-of-the-year and 27 (4"-8") steelhead in the fall).

Eastern Sub-basin

McGinnis Creek (RM 8.0)

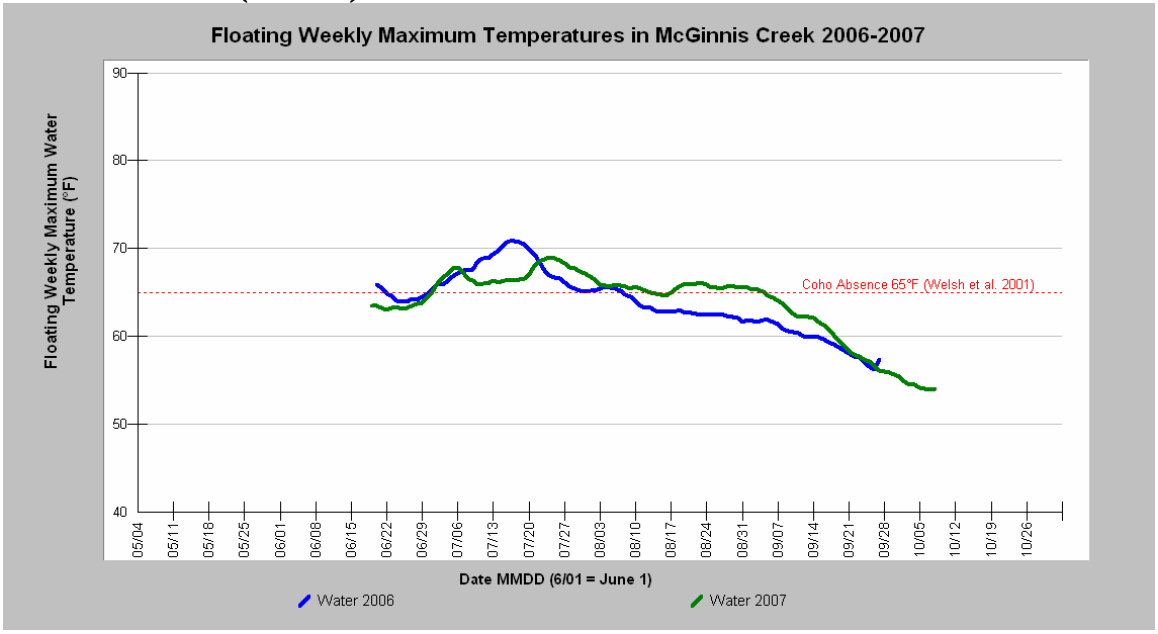


Figure 29. Floating Weekly Maximum Temperatures in McGinnis Creek, 2006-2007.

Floating weekly maximum water temperature (MWMT) in McGinnis Creek surpassed 65°F in both 2006 and 2007, indicating temperatures were too warm for coho salmon rearing (Welsh et al. 2001) (See Figure 29). MWMT exceeded the coho threshold for the duration of July. The maximum temperature recorded in McGinnis was 70.50°F on 7/23. Coates et al. (2002) would characterize McGinnis Creek (64.27°F MWAT) as poor thermal habitat for coho (>63.0°F) but marginal for steelhead (63.0-66.0°F MWAT). However, temperatures in the creek are much more favorable for oversummering salmonids than in the nearby mainstem Mattole. The temperature logger in the Mattole just upstream of McGinnis recorded a maximum temperature of 84.95°F in 2006.

Only steelhead are known to reside in McGinnis Creek, according to past MSG monitoring. The average parcel size in the drainage is relatively large (81 acres). Much of the upper drainage is timberland, while the lower reach is ranchland. The lower section is heavily impacted by sediment and contains little favorable salmonid habitat. Surveyors noted McGinnis Creek was a

small trickle with much of the flow subsurface below fine sediment at its confluence with the Mattole in both the spring and fall of the past two years.

Three hundred seventy-three steelhead young-of-the-year and 10 (4"-8") stelhead were observed during the spring snorkel survey on 6/15/07. There was no fall dive. Neither coho salmon nor Chinook salmon juveniles have been observed during snorkel surveys in the McGinnis Creek reach.

Gilham Creek (RM 32.8)

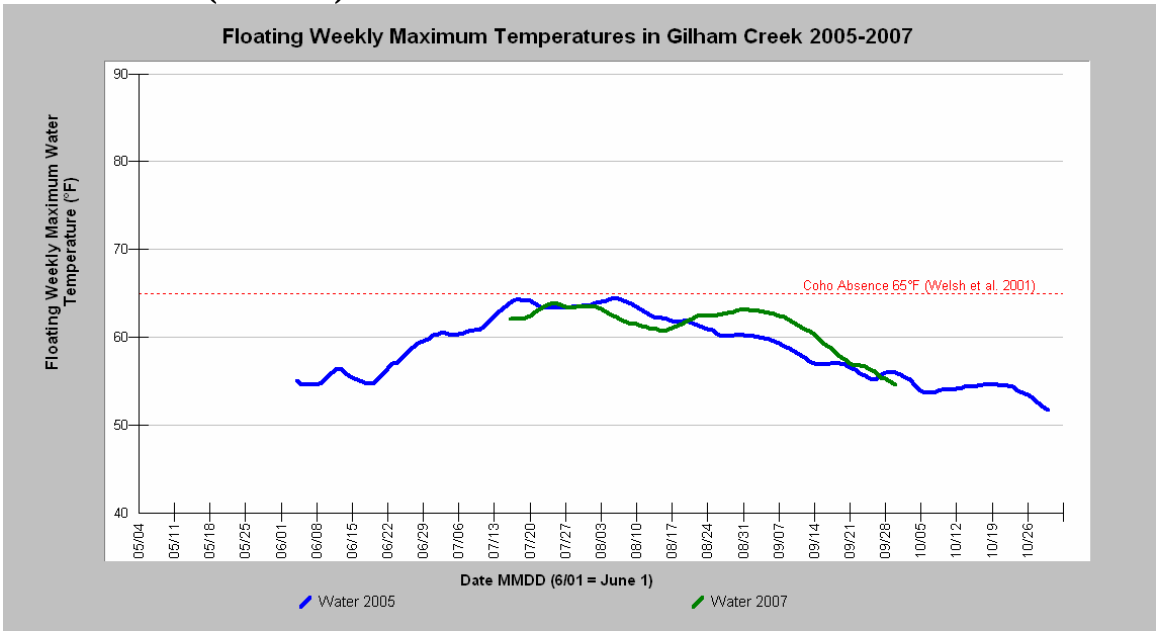


Figure 30. Floating Weekly Maximum Temperatures in Gilham Creek, 2005 and 2007.

Temperature monitoring occurred in Gilham Creek in 2005 and 2007. Floating Weekly Maximum Temperatures remained below 65°F, favorable for coho utilization (Welsh et al. 2001) (See Figure 30). 2007 MWAT (62.21°F) also indicated temperatures were suitable for coho (<63°F), although thermal habitat was more appropriate for steelhead (Coates et al. 2001). Maximum temperatures in Gilham Creek remained cool enough that salmonids were not subject to acute or chronic temperature stress. The maximum temperature recorded was 64.67°F on 7/23.

The Gilham Creek subshed contains a notable amount (31%, 585 acres) of old growth forest. Parcel sizes tend to be large, and the BLM owns and manages 34% of the drainage. The remote qualities and remaining forest no doubt contribute to favorable thermal habitat in Gilham Creek. The mainstem Mattole often reaches lethal temperatures here, thus Gilham Creek is important for salmonids both as a source of cool water and a refuge from high temperatures.

Past and present snorkel surveys in Gilham Creek have found only steelhead. In 2007, divers found 104 steelhead young-of-the-year in the spring and 88 in the fall. Lesser numbers of 4"-8" steelhead were also observed (4 in the spring and 13 in the fall).

Blue Slide Creek (RM 42.0)

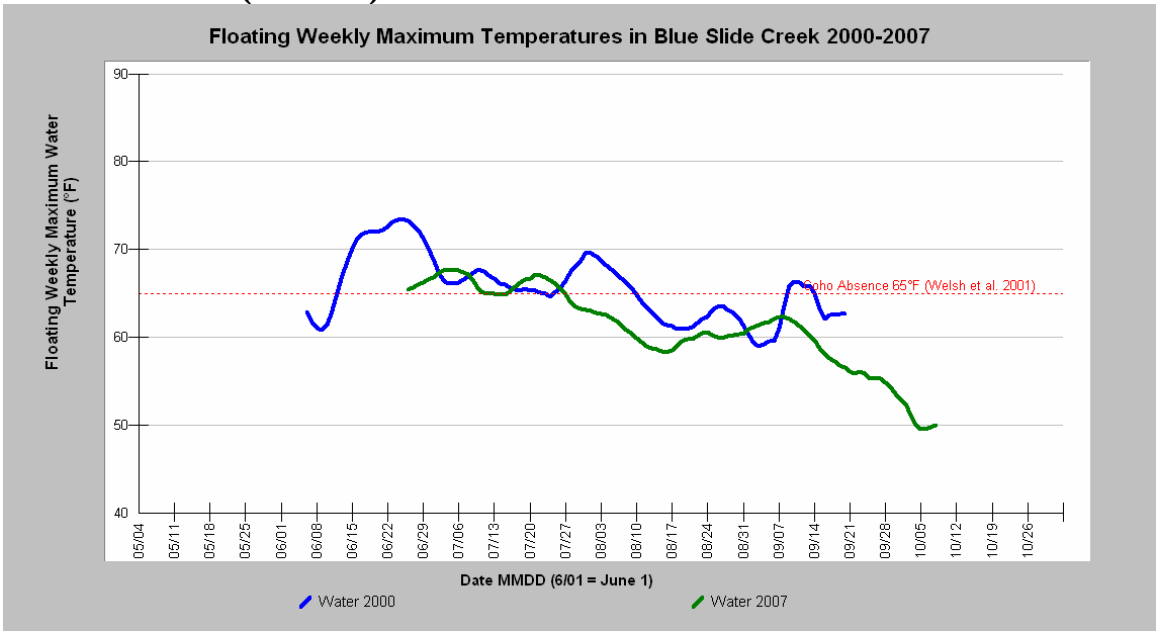


Figure 31. Floating Weekly Maximum Temperatures in Blue Slide Creek, 2000-2007.

Existing MSG temperature data for Blue Slide Creek includes the summers of 2000 and 2007. Although 2007 temperatures were often cooler, floating weekly maximum temperatures exceeded 65°F during both years, thus temperatures were too warm to support coho according to the criteria developed by Welsh et al. (2001) (See Figure 31). The 2007 MWAT (64.37°F) also showed temperatures were above thresholds for coho (<63°F), although well within the acceptable limit for steelhead (<66°F). The maximum temperature recorded in 2007 was 69.6°F. Temperatures were warmer than 68°F on 3 of 111 days of monitoring.

According to historical presence/absence data, only steelhead have even known to inhabit Blue Slide Creek. In 2007, steelhead were observed in the spring. There was no dive in the fall due to poor visibility. Surveyors noted fine sediment impaired visibility.

Deer Lick Creek (RM 45.9)

2007 marked the first year of temperature monitoring in Deer Lick Creek. Floating weekly maximum temperatures slightly exceeded 65°F on one occasion, indicating temperatures were usually suitable for coho salmon rearing (Welsh et al. 2001) (See Figure 32). The 2007 MWAT (61.88°F) suggested temperatures could support coho (59-63°F is marginal), and thermal habitat would be good for steelhead (<63°F). Maximum temperatures remained below thresholds for acute and prolonged temperature stress for salmonids. The maximum temperature recorded in Deer Lick Creek in 2007 was 66°F.

Both past and present MSG snorkel surveys have found only steelhead in Deer Lick Creek. In 2007, 168 steelhead young-of-the-year were observed in the spring and 50 in the fall. Small numbers of 4”-8” steelhead were also observed.

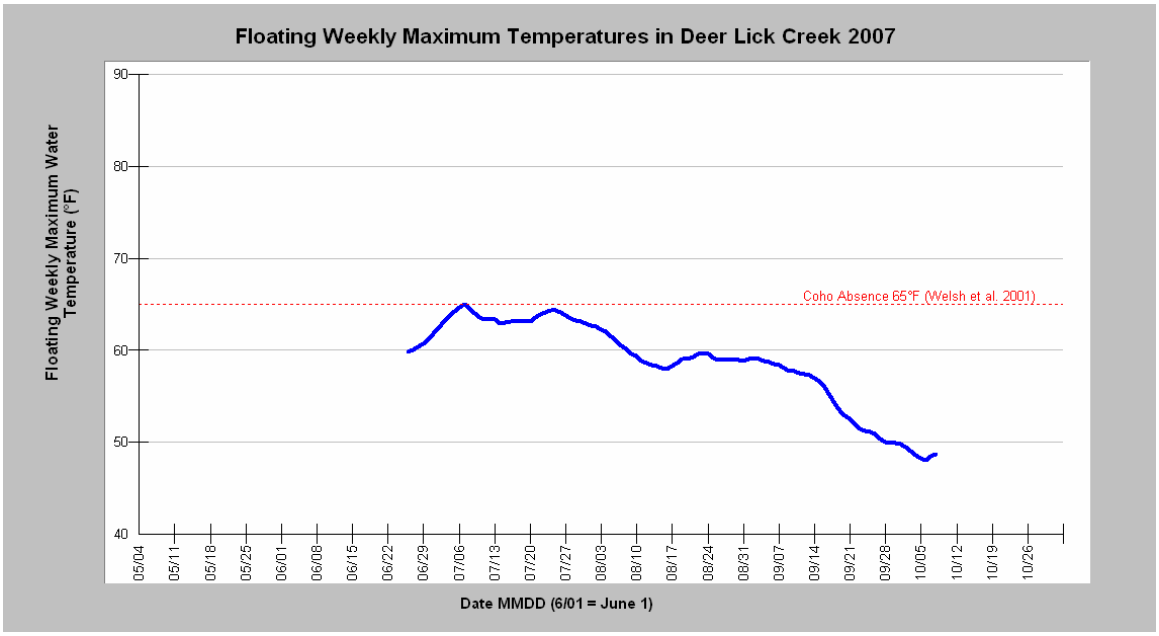


Figure 32. Floating Weekly Maximum Temperatures in Deer Lick Creek 2007.

Eubanks Creek (RM 47.7)

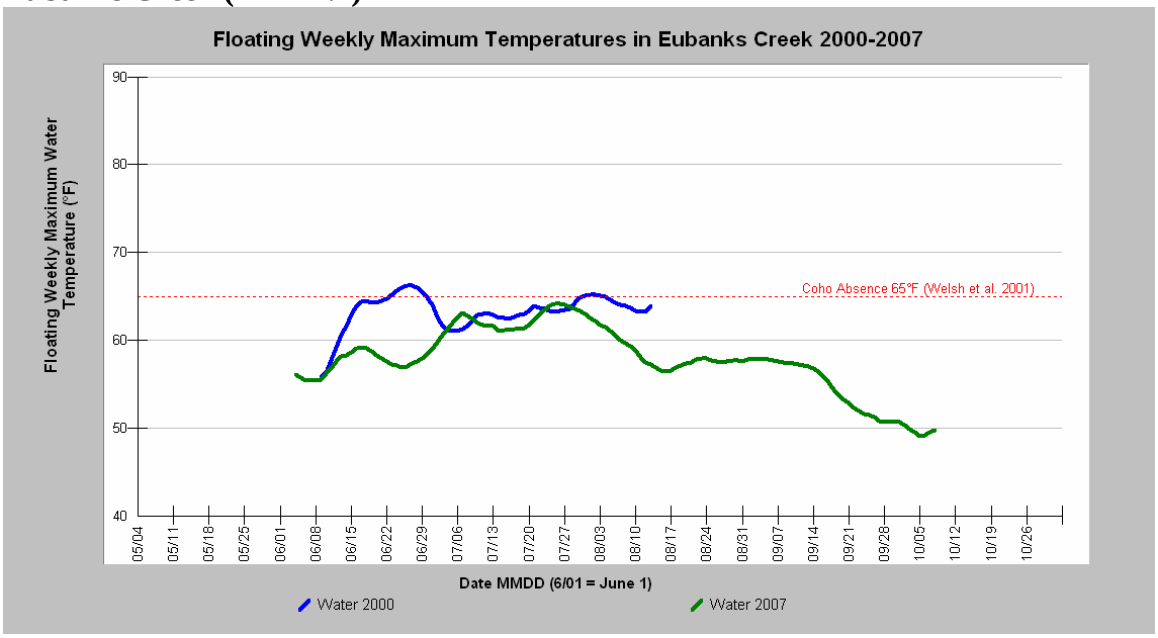


Figure 33. Floating Weekly Maximum Temperatures in Eubanks Creek 2000-2007.

The MSG monitored temperatures in Eubanks Creek in 2000 and 2007. Floating weekly maximum water temperatures exceeded 65°F in 2000 but not in 2007, indicating temperatures are suitable for coho salmon rearing in some years (Welsh et al. 2001) (See Figure 33). Data after August 16th, 2000 was not included due to the pool in which the logger was recording temperatures being dry. In some years, habitatin Eubanks Creek is limited by low flows. In 2007, MWAT (61.21 °F) indicated thermal habitat in Eubanks Creek was marginal for coho but

good for steelhead. Temperatures in Eubanks Creek in 2007 reached a maximum of 64.8°F, cool enough to spare rearing salmonids from prolonged or acute thermal stress.

Historically, steelhead, Chinook, and coho have been found in Eubanks Creek. In 2007, divers saw only steelhead. More steelhead young-of-the-year were observed in the spring (174) than in the fall (35). Surveyors also found small numbers of 4"-8" steehead in the spring and fall and a single >8" steelhead on 5/31/07.

McKee Creek (RM 52.8)

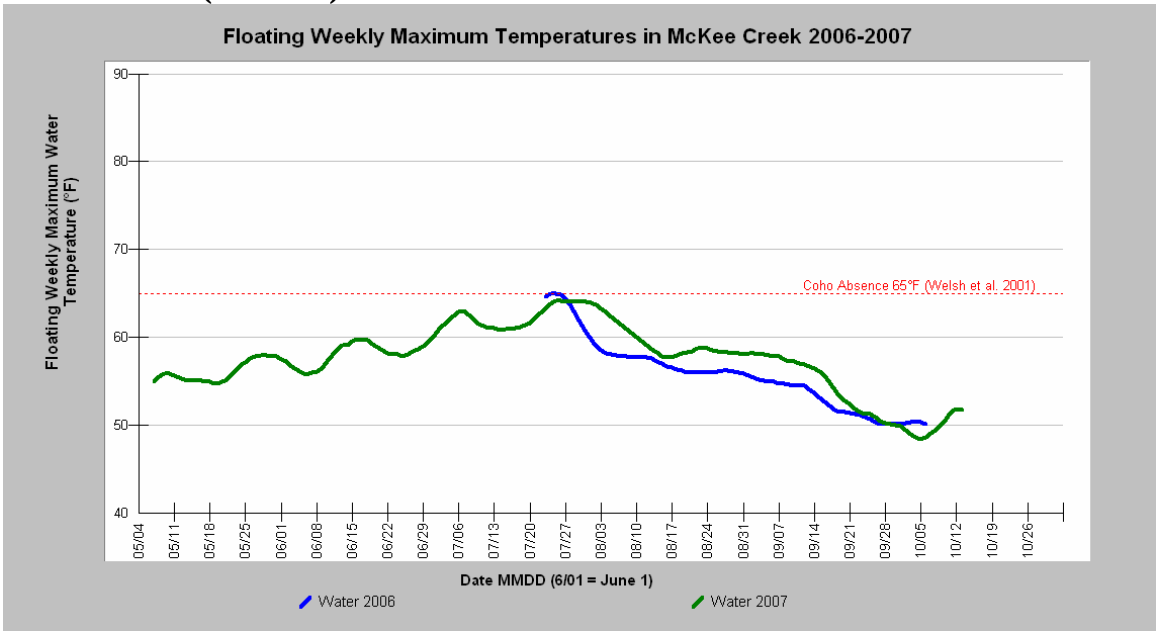


Figure 34. Floating Weekly Maximum Temperatures in McKee Creek 2006-2007.

McKee Creek was monitored for temperature during the past two summers. Floating weekly maximum water temperatures remained cooler than 65°F in 2006 and 2007, indicating temperatures were suitable for coho rearing (Welsh et al. 2001) (Figure 34). According to thresholds determined by Coates et al. (2002), the 2007 MWAT (62.07°F) signifies favorable thermal habitat for steelhead (<63.0°F) and marginal thermal habitat for coho (59.0-63.0°F). The maximum temperature recorded in McKee Creek in 2006 was 65.06°F, providing evidence salmonids in McKee Creek were not subject to acute or prolonged stress due to high temperatures.

Despite favorable temperatures, McKee Creek provides limited habitat for juvenile salmonids during the later part of the summer and in early fall before the rains. While the creek still had significant flows in July, by October McKee had dried to a series of disconnected pools near its confluence with the Mattole. Other water quality factors such as dissolved oxygen may threaten juvenile salmonids during times of low flow in the creek.

In 2007, MSG divers identified small numbers of steelhead (13 young-of-the-year, 7 (4"-8")), Chinook (7 young-of-the-year), and coho (1 young-of-the-year) in McKee Creek during the spring dive on 5/3. By the fall dive on 10/17, only 6 steelhead young-of-the-year and 2 (4"-8")

steelhead were observed. Past survey data also indicates Chinook, coho, and Chinook utilize McKee Creek.

Southern Sub-basin

Bridge Creek (RM 52.8)

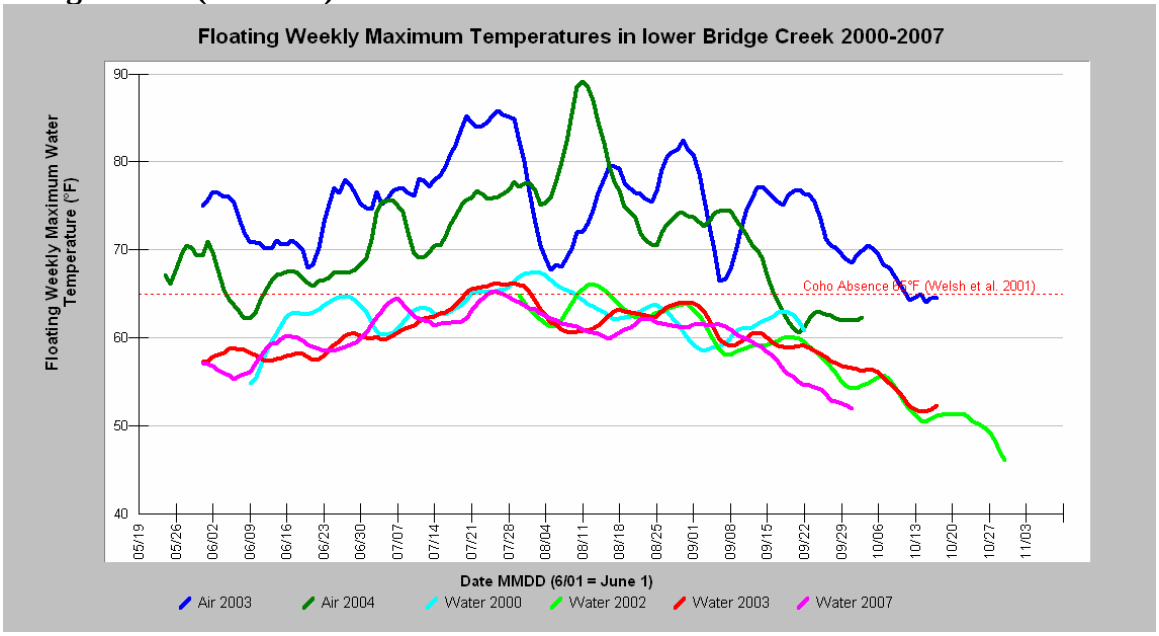


Figure 35. Floating Weekly Maximum Temperatures in Bridge Creek 2003-2007.

The MSG monitored temperature in Bridge Creek just upstream from its confluence with the Mattole in 2000, 2002, 2003, 2004, and 2007. Air temperature data was also collected in 2003-2004. Floating weekly maximum water temperature (MWMT) exceeded 65°F during all years monitored (2000, 2002, 2003, and 2007), indicating temperatures were not suitable for coho salmon rearing (Welsh et al. 2001) (Figure 35). In 2004, the temperature logger in the creek was damaged and data was not retrievable. Temperatures recorded in 2007 were slightly cooler than other years on record, surpassing 65°F MWMT only slightly. The MWAT in 2007 (61.47°F) showed temperatures provided marginal habitat for coho (59.0-63.0°F) and good habitat for steelhead (<63.0°F) (Coates et al. 2002). The maximum temperature recorded in 2007 was 65.96°F, below thresholds for acute or prolonged thermal stress for rearing salmonids.

Historical salmonid presence in Bridge Creek confirmed by MSG divers includes steelhead, Chinook, and coho. In 2007, divers saw 58 steelhead in the spring and 33 in the fall; no salmon were observed.

Van Arken Creek (RM 54.0)

MSG temperature monitoring occurred in Van Arken Creek during the summers of 2000, 2004, and 2007. During all years of monitoring, floating weekly maximum water temperatures remained below 65°F, indicating temperatures were suitable for coho salmon rearing (Welsh et al. 2001) (Figure 36). 2007 MWAT (60.51°F) showed thermal habitat was marginal for coho (59.0-63.0°F) and good for steelhead (<63.0°F) (Coates et al. 2002).

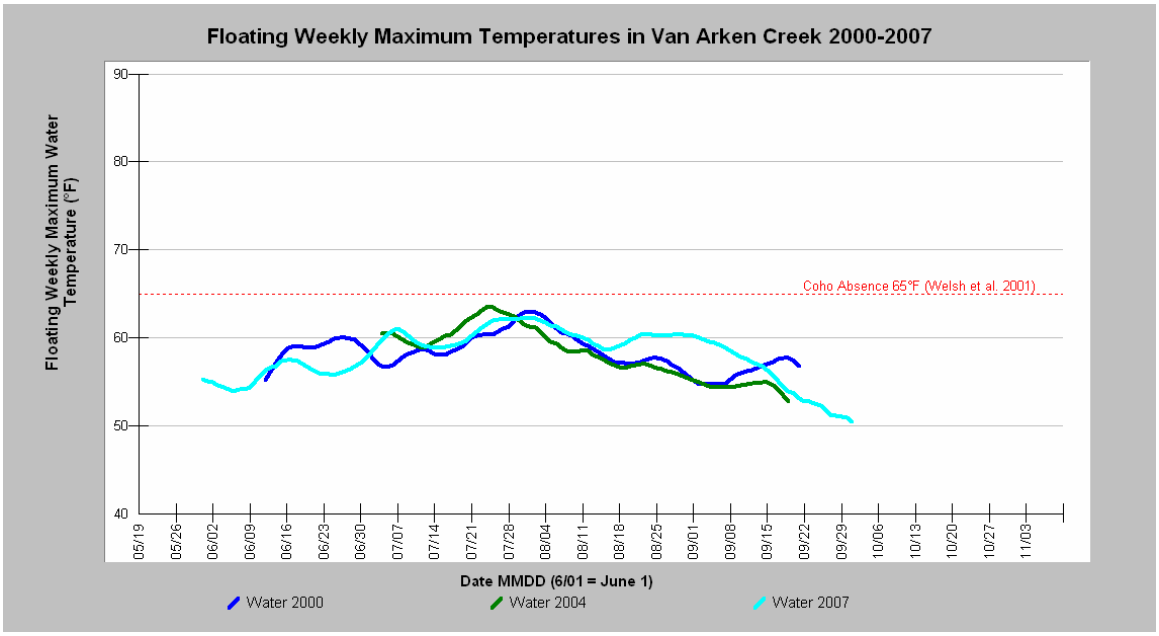


Figure 36. Floating Weekly Maximum Temperatures in Van Arken Creek 2000-2007.

The Van Arken Creek subshed is mainly second growth forest with no old growth remaining. Most of the drainage is managed for timber. Sediment accumulation is noticeable in the creekbed especially in pools. However, water temperatures remain cool and there is riparian cover and habitat complexity provided by large wood. Salmonids are consistently observed here. In fall of 2007, the creek was dry and limited to disconnected pools near the confluence.

Historically, both coho and steelead have been found in Van Arken Creek. In 2007, MSG divers observed both species. Thirty-eight steelhead and one coho young-of-the-year were identified on May 27, 2007. In fall 2007, divers observed 1 steelhead. Only steelhead were found in 2000.

Upper Mill Creek (RM 56.2)

The lower section of Upper Mill Creek was monitored in 2002-2004 and in 2007. Air temperatures were also recorded in 2002-2004. Floating weekly maximum water temperatures remained below 65°F during all years on record (2002-2004 and 2007), indicating temperatures were suitable for coho salmon rearing (Welsh et al. 2001) (Figure 37). The maximum average temperature of any seven day period (MWAT) in 2007 was 60.64°F, which is considered marginal thermal habitat for coho (59-63°F) and more favorable for steelhead (<63°F) (Coates et al. 2002). Temperatures in Upper Mill Creek reached a high of 63.52°F, well below thresholds for acute or prolonged thermal stress for salmonids.

In 2002-2004, temperature and monitoring also occurred in the upper reach of Upper Mill Creek. Temperatures here were even cooler than in the lower reach; floating weekly maximum temperatures were usually below 60°F.

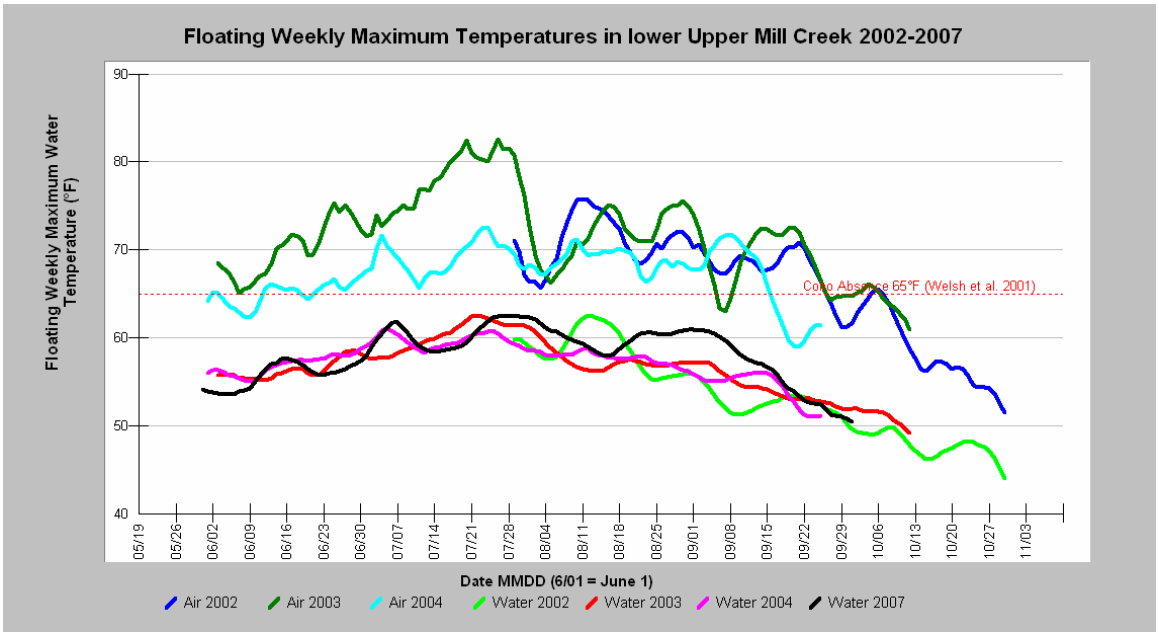


Figure 37. Floating Weekly Maximum Temperatures in Upper Mill Creek 2002-2007.

Coho, Chinook. and steelhead have been observed in Upper Mill Creek in the past. In 2007, MSG divers located 43 steelhead young-of-the-year and 1 Chinook in the spring and 4 steelhead young-of-the-year in the fall. During 2002-2004, five dive surveys were conducted in Upper Mill Creek. Coho were observed in both upper and lower reaches during all 2002-2004 surveys. The maximum number of coho observed in the lower reach was 36 on 7/25/02. Coho were even more numerous in the upper reach of Upper Mill; 58 were identified on 5/30/03.

Baker Creek (RM 57.6)

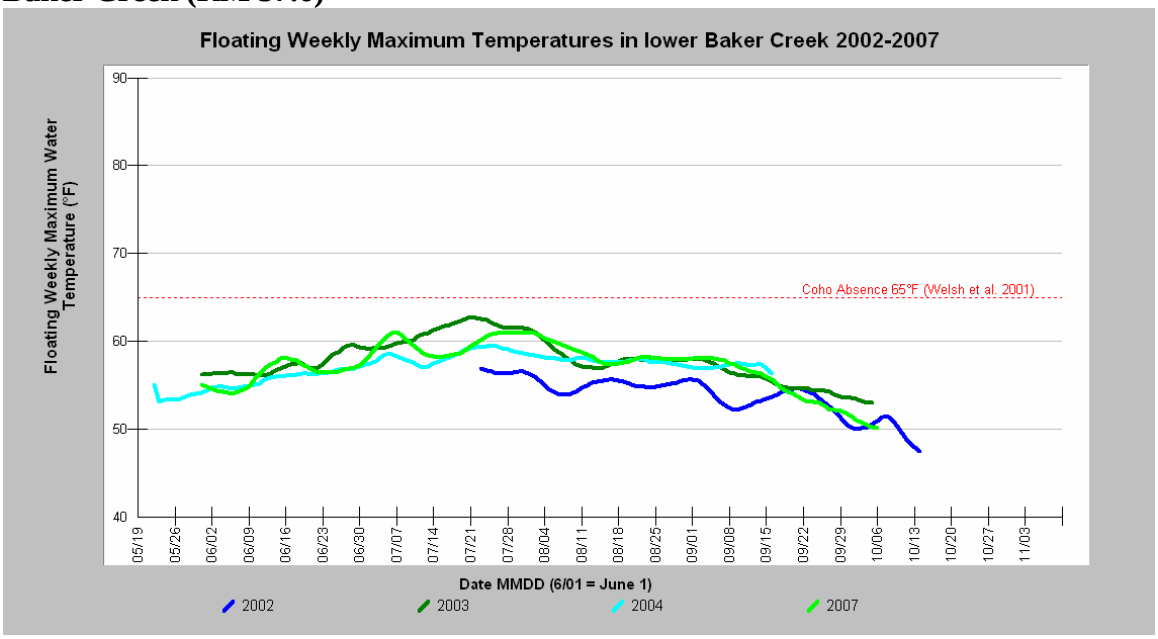


Figure 38. Floating Weekly Maximum Temperatures in Baker Creek 2002-2007.

Temperature monitoring in Baker Creek occurred in 2002-2004 and in 2007. Floating weekly maximum water temperature did not exceed 65°F during any monitoring year, indicating temperatures were suitable for coho salmon rearing (Welsh et al. 2001) (Figure 38). 2007 MWAT (60.38°F) suggested marginal thermal habitat for coho (59.0-63.0°F) and good thermal habitat for steelhead (<63.0°F). The maximum temperature recorded in Baker Creek in 2007 was 62.06°F, indicating neither acute or prolonged thermal stress was a problem encountered by salmonids oversummering in Baker Creek.

Historical salmonid presence observed in Baker Creek includes steelhead, Chinook, and coho. Six dive surveys were conducted in lower Baker Creek in spring and fall 2002 - 2004, with 10 pools snorkeled in each survey. Coho and steelhead were observed in five out of six surveys. Five juvenile Chinook salmon were observed during surveys in the spring of 2004. In 2007, MSG divers identified significant numbers of coho in the spring (71). Additionally, 48 steelhead young-of-the-year and 1 (4"-8") steelhead were observed. In the fall, the dive followed a 3" rain; only 2 steelhead young-of-the-year were observed.

Thompson Creek (RM 58.4)

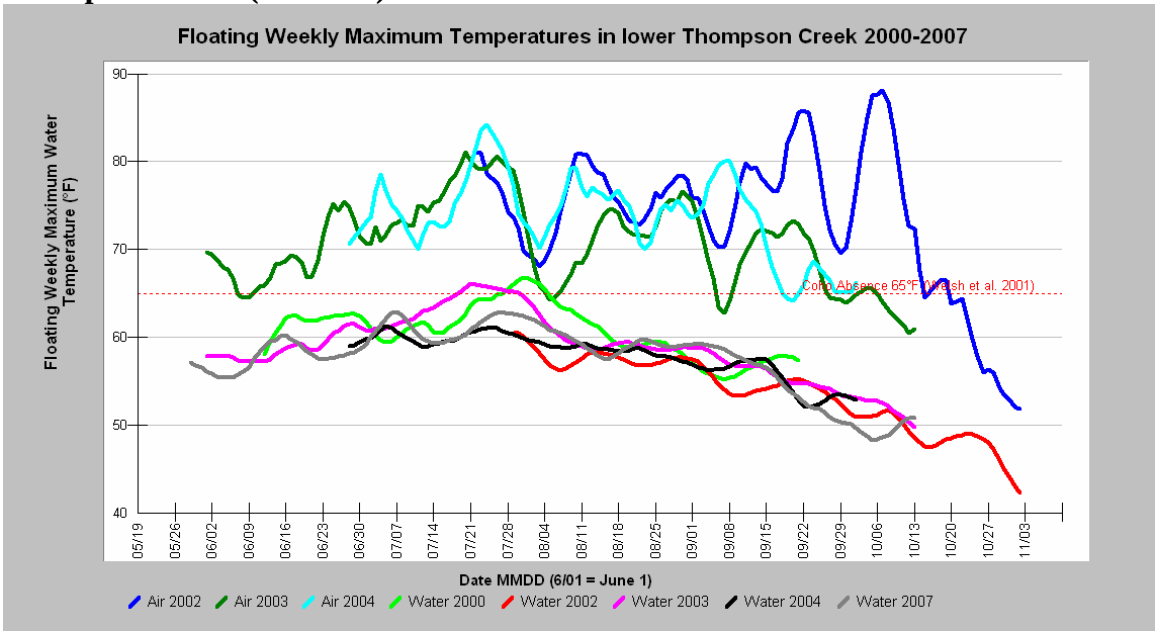


Figure 39. Floating Weekly Maximum Temperatures in Thompson Creek 2002-2007.

Water temperature monitoring in Thompson Creek occurred in 2000, 2002-2004, and in 2007. Air temperatures were also monitored in 2002-2004. Floating weekly maximum water temperatures exceeded 65°F in 2000 and 2003, indicating temperatures were not suitable for coho salmon rearing during those years. Temperatures remained cool enough to be suitable for coho in 2002, 2004, and 2007 (Welsh et al. 2001) (Figure 39). In 2007, the MWAT was 61.51°F, marginal thermal habitat for coho (59-63°F) and good thermal habitat for steelhead (<63°F) (Coates et al. 2002). The maximum temperature recorded in 2007 was a cool 64.25°F, further showing favorable thermal habitat in Thompson Creek.

In addition to cool habitat, Thompson Creek provides other positive salmonid habitat attributes, such as good riparian cover and habitat complexity, including deep pools and abundant small and

large woody debris. 11% old growth remains in the drainage, and the rest of the creek is relatively shaded. Thompson Creek is also home to numerous MSG wood structures, completed as part of old habitat restoration projects.

Historically, steelhead, Chinook, and coho were found in Thompson Creek. Dive surveys in 2007 found all three species in relative abundance during both spring and fall surveys. Twenty-three coho and 17 Chinook young-of-the-year were observed in the spring. Both species of salmon appeared to experience excellent oversummer survival and growth in Thompson Creek. Eleven Chinook were observed in the fall, and had graduated to the 4"-8" size class. Divers found 6 less than 4" coho and 24 4"-8" coho in the fall. Steelhead were also observed in the spring (246 young-of-the-year and 26 (4"-8")) and fall (92 young-of-the-year and 6 (4"-8")).

Yew Creek (RM 58.4 + 0.15)

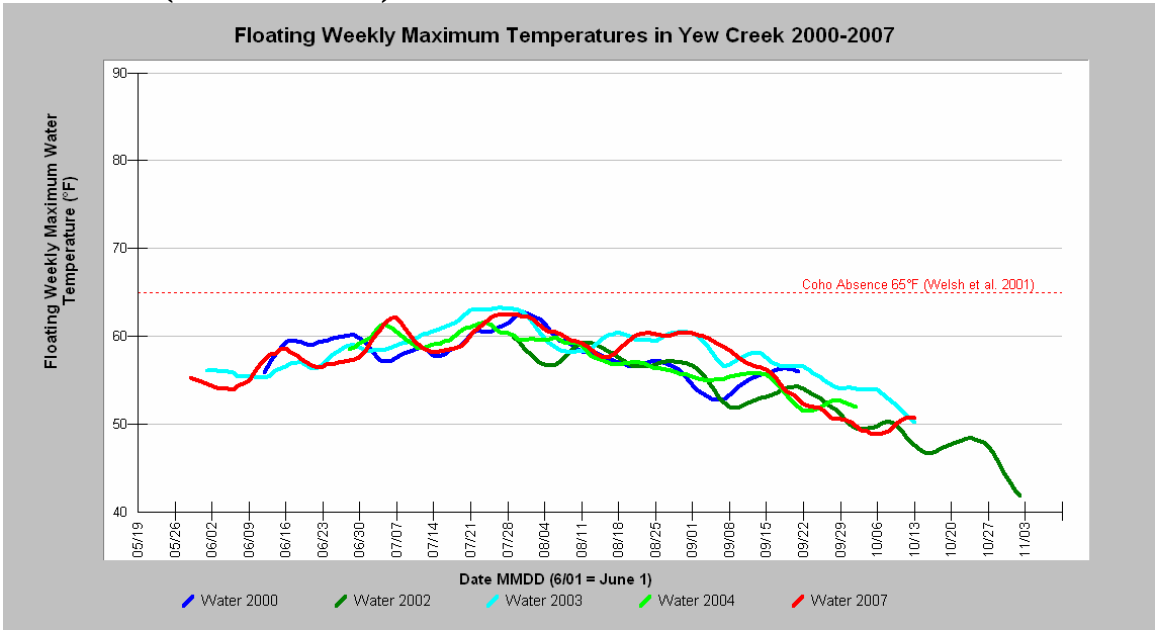


Figure 40. Floating Weekly Maximum Temperatures in Yew Creek 2000-2007.

Temperature monitoring occurred in Yew Creek in 2000, 2002-2004, and in 2007. Floating weekly maximum water temperature remained below 65°F during all years on record (2000, 2002-2004 and 2007), indicating temperatures were suitable for coho salmon rearing (Welsh et al. 2001) (Figure 40). According to MWAT criteria determined by Coates et al. (2002), thermal habitat in Yew Creek in 2007 was marginal for coho (59.0-63.0°F) but good for steelhead. The 2007 MWAT in Yew Creek was 60.25°F. Temperatures in Yew Creek reached a high of 63.73°F in 2007, well below thresholds for acute and prolonged thermal stress for salmonids.

Observations support Yew Creek as very favorable juvenile salmon oversummering habitat. Dives in recent years as well as historical dives have found coho, Chinook, and steelhead in abundance in Yew Creek. During the spring dive on 5/25, MSG staff observed 5 steelhead, 10 Chinoook, and 87 coho. All were young-of-the-year. Dive counts showed excellent oversummer survival and growth. By the fall, some of the coho and Chinook had grown enough to be

classified in the larger (4”-8”) size class. Divers found 2 >4” and 3 (4”-8”) Chinook. Fall coho counts were even more numerous (21 <4” and 24 (4”-8”)).

Helen Barnum Creek (RM 58.9)

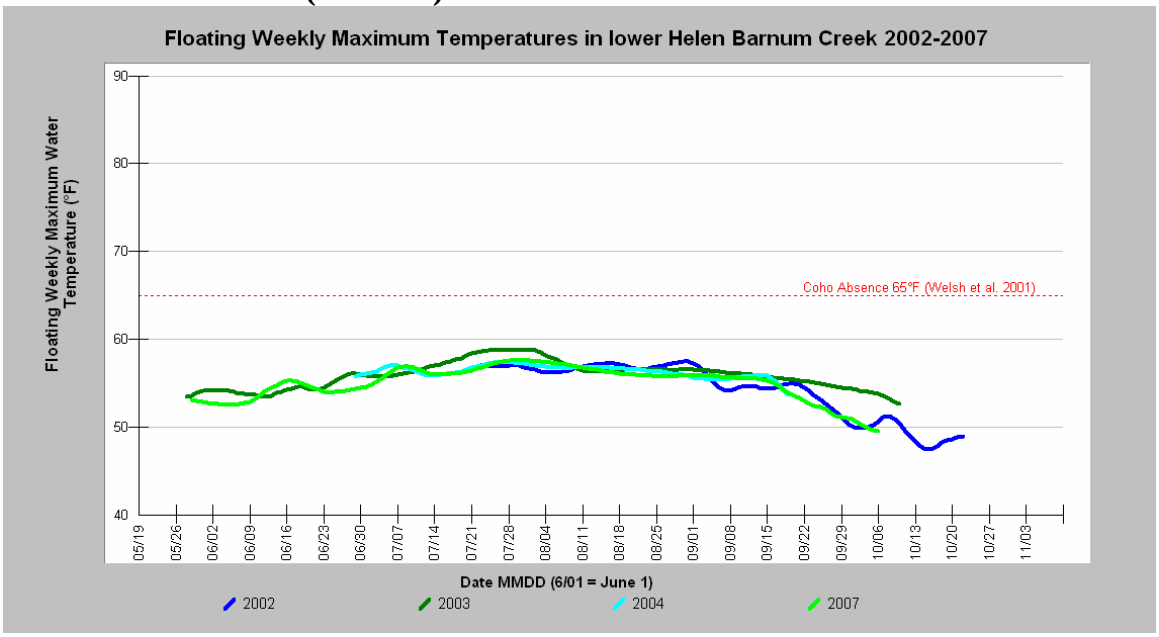


Figure 41. Floating Weekly Maximum Temperatures in Helen Barnum Creek 2002-2007.

Helen Barnum Creek was monitored in 2002-2004 and in 2007. Floating weekly maximum water temperatures remained below 65°F during all years monitored, indicating temperatures were suitable for coho salmon rearing (Welsh et al. 2001) (Figure 41). 2007 MWAT (57.32°F) also showed favorable temperatures for both coho (<59°F) and steelhead (<63°F) (Coates et al. 2002). Even during the peak of high temperatures, Helen Barnum Creek remained favorable thermal habitat for salmonids. The maximum temperature recorded in Helen Barnum Creek in 2007 was 57.68°F, showing salmonids here would have avoided thermal stress.

Despite cool temperatures, divers did not observe salmonids oversummering in Hele Branum Creek. In 2007, accumulated sediments formed a 6’ impounded earthen wall, which presented a barrier to salmonid migration. Removal of the barrier is necessary for salmonid habitat utilization, as the barrier is only about 100 feet upstream of the confluence. Past survey data in Helen Barnum Creek indicates only steelhead presence.

Lost River Creek (RM 58.8)

The MSG monitored water temperature in Lost River Creek in 2002-2004 and in 2007. Air temperatures were also recorded in 2002 and 2003. Floating weekly maximum water temperatures exceeded 65°F only during 2004, indicating temperatures are suitable for coho salmon rearing during most years (Welsh et al. 2001) (Figure 42). In 2007, the MWAT in Lost River was 59.62°F, suggesting thermal habitat is marginal for coho and good for steelhead (Coates et al. 2002). Maximum temperatures in Lost River Creek remained cool throughout the summer. The peak temperature recorded was 60.6°F, well below thresholds for prolonged or acute thermal stress.

The lower reach of Lost River dries up by the fall during some years, becoming a series of disconnected pools, and turns out to be less than favorable salmonid habitat despite cool temperatures. In 2007, the confluence to 100 feet upstream was dry, and the rest of the reach was a series of disconnected pools with questionable water quality. Low flow problems in this reach may contribute to salmonid mortality as water quality becomes poor in isolated pools. The entire survey reach was dry in 2004, and therefore unsuitable for any salmonid rearing.

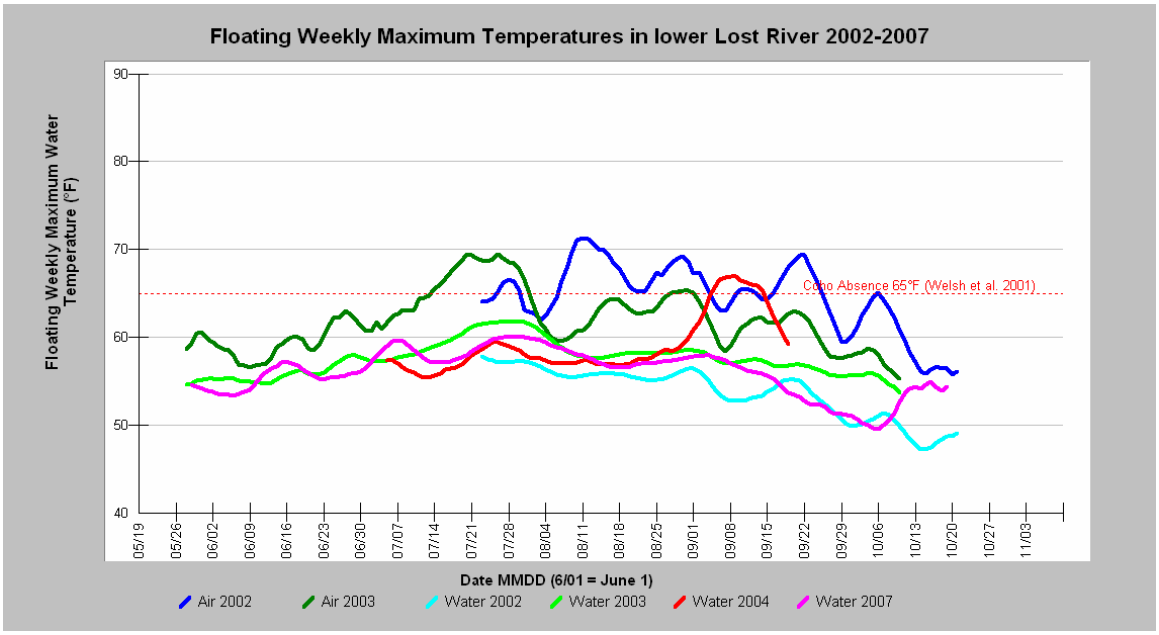


Figure 42. Floating Weekly Maximum Temperatures in Lost River Creek 2002-2007.

Based on past MSG data, historical salmonid presence in Lost River includes coho salmon and steelhead. Coho and steelhead are often seen in Lost River when the water is flowing. In 2007, MSG divers found 50 steelhead young-of-the-year, and 6 coho young-of-the-year during the spring. By the fall, only 16 steelhead young-of-the-year were observed.

Ancestor Creek (RM 60.8)

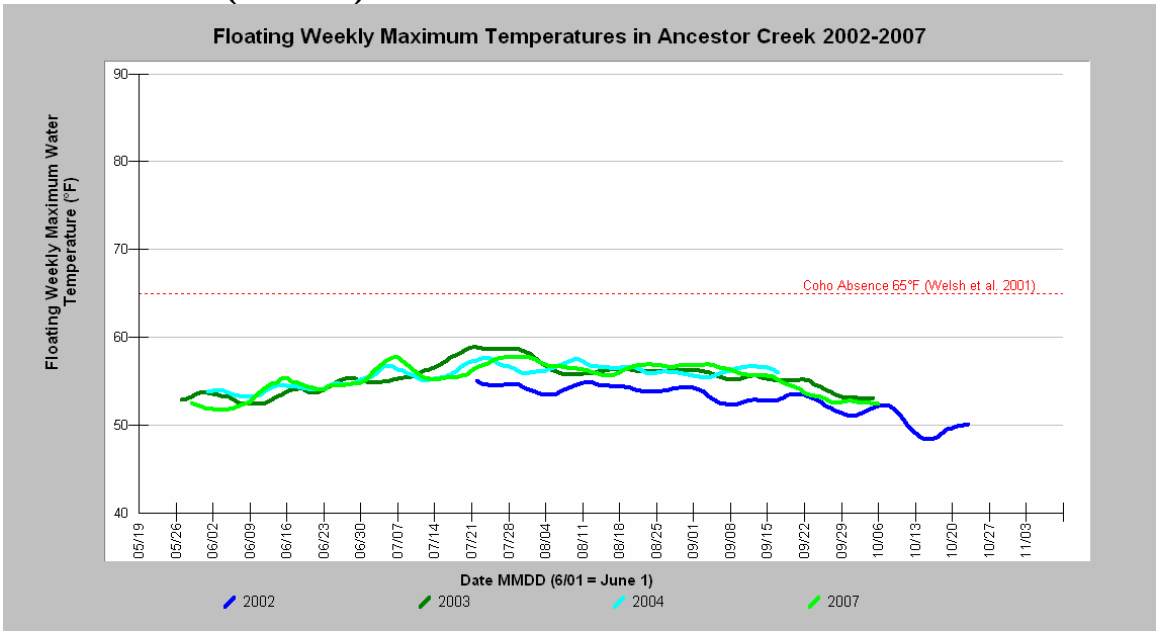


Figure 24. Floating Weekly Maximum Temperatures in Ancestor Creek 2002-2007.

Temperature monitoring in Ancestor Creek occurred in 2002-2004 and in 2007. Floating weekly maximum water temperatures remained below 65°F during all years monitored, demonstrating suitable thermal habitat for coho salmon rearing. The maximum weekly average temperature (MWAT) recorded in 2007 was 56.8°F, favorable temperatures for both juvenile coho salmon (<59.0°F) and steelhead (<63.0°F) (Coates et al. 2002). Temperatures near the Mattole headwaters and in the uppermost tributaries like Ancestor Creek remain cool throughout the summer and represent the coolest and likely the best locations in the watershed for salmonid oversummering, especially for coho, the Mattole species most vulnerable to high temperatures (Welsh et al. 2001, Coates et al. 2002). The maximum temperature reached in Ancestor Creek in 2007 was 59.19°F on 7/6/07.

MSG surveyors have located juvenile coho salmon in Ancestor Creek on all seven dive surveys conducted since 2002. In 2007, juvenile coho salmon were observed in Ancestor Creek during both the spring (38) and fall (1) dive. Four juvenile Chinook were also observed during the spring dive. Much of the Ancestor Creek drainage is state park property, and past surveys have found habitat is favorable for juvenile coho salmon, due to both low temperatures and habitat complexity, including large woody debris. In 2007, surveyors noted Ancestor Creek had greater flow than the Mattole at its confluence.

Conclusion

Temperature has been determined to be a major limiting factor to salmonid abundance and survival in the Mattole Watershed. An increase in stream temperatures in the Mattole basin during the last four decades as a result of channel aggradation, widening, and the removal of riparian cover is a key factor restricting salmonid distribution and abundance in their historical range. The life stage of salmonids most vulnerable to increased temperature is the growth phase (Brungs and Jones 1977). Juvenile salmonids in the Mattole during the summer months are

exposed to increased water temperature, low flows and lack of riparian shading. Summer water temperatures in some reaches of the lower Mattole regularly reach 78.0°F, and temperatures over 66.0°F in many tributary locations are not uncommon.

Lack of oversummering habitat and energetic constraints to feeding and growth due to high water temperatures have contributed to reduced run strength for Chinook and coho salmon present in the Mattole River. Downstream Migrant data on Chinook salmon indicates Chinook salmon are migrating to the ocean at substandard size for ocean survival (MSG 2006, Reimers 1973).

Juvenile coho have the lowest tolerance to high temperature of any anadromous species in the Mattole Watershed (Coates et al. 2002). Three hundred and sixty coho salmon were observed during dive surveys in the Mattole and selected tributaries in 2007. Most coho observed in 2007 were observed during the spring dives (262); in comparison, MSG divers located 98 coho in the fall. Coho were observed in ten tributaries in 2007, including Ancestor Creek (RM 60.8), Lost River (RM 58,8), Thompson Creek (RM 58.4), Yew Creek (RM 58.4+0.15), Baker Creek (RM 57.8), Van Arken Creek (RM 54.0), McKee Creek (RM 52.8), Fourmile Creek (RM 34.6), Woods Creek (RM 24.1), and Lower Mill Creek (RM 2.8). In the spring, divers found coho in nine Mattole tributaries. By fall, observations of coho occurred in only five tributaries.

The criteria developed by Welsh et al. (2001) correctly identified coho presence in 14 of 35 tributary reaches where juvenile dive surveys and temperature monitoring were conducted in the Mattole in 2007. Fourmile Creek (RM 34.6) was the only tributary with MWMT above 65.0°F where coho were observed. In thirteen monitoring locations (Helen Barnum Creek (RM 58.9), Upper Mill Creek (RM 56.2), Eubanks Creek (RM 47.7), Big Finley Creek (RM 47.4), Jewett Creek (RM 42.8+~3.0), South Fork Bear Creek (RM 42.8+~6.0), Sholes Creek (RM 36.6), Gilham Creek (RM 32.8), Upper Honeydew Creek (RM 26.4 +~2.5), Clear Creek (RM 6.1), East Mill Creek (RM 5.4), Stansberry Creek (RM 1.3), and Lower Bear Creek (RM 1.0)) floating weekly maximum temperatures remained below the coho threshold, but coho were not observed.

Of these, seven tributaries (Helen Barnum Creek (RM 58.9), Upper Mill Creek (RM 56.2), Eubanks Creek (RM 47.7), Big Finley Creek (RM 47.4), Sholes Creek (RM 36.6), Clear Creek (RM 6.1), and East Mill Creek (RM 5.4)) have historically had coho presence, but no coho were observed in 2007. Coho presence in three locations (upper reach of Honeydew Creek and two tributaries of Bear Creek: Jewett Creek and South Fork Bear) has not been determined previously, although coho are known to reside in the Bear and Honeydew Creek subsheds. In the remaining three tributaries, Gilham Creek (RM 32.8), Stansberry Creek (RM 1.3) and Lower Bear Creek (RM 1.0+~0.3), past and present temperature monitoring has indicated cool thermal habitat, but coho have never been observed. Lower Bear Creek and Helen Barnum Creek have barriers impassable to salmonids.

In the lower Mattole, Woods Creek (RM 24.1) and Lower Mill Creek were the only tributaries with an observed coho were population. Fourmile Creek (RM 34.6) was the only location in the middle Mattole where coho were observed. All three of these creeks are located in the Mattole's western subbasin. MSG divers did not find coho in any tributaries in the northern or eastern

subbasins. Most tributaries where coho were observed in 2007 were in the southern subbasin or upper Mattole, nearest the headwaters.

In the mainstem Mattole, coho were observed exclusively in the upper Mattole (southern subbasin, upstream of Bridge Creek at RM 52.1) during 2007 dive surveys. A small number of coho were also found in the MSG's downstream migrant trap at RM 3.9.

Floating Weekly Maximum Temperatures in six of ten upper Mattole mainstem temperature monitoring sites exceeded suitable temperatures for coho rearing (Welsh et al. 2001). Temperatures remained below the coho threshold at the four uppermost locations (Mattole upstream of Ancestor Creek (RM 60.8), MS-1 (RM 59.4), MS-2 (RM 58.9), and Mattole upstream of Thompson Creek (RM 58.5). This emphasizes the importance of the very upper Mattole mainstem and tributaries as the best rearing habitat in the Watershed for juvenile coho.

Although temperatures are most favorable and coho habitat most abundant near the Mattole headwaters, low-flow in this area (especially in drier years) has resulted in water quality issues, namely low dissolved oxygen levels. Low-flow issues in the upper Mattole presents a dire threat to oversummer juvenile salmonid survival. Salmonids rearing here are at risk of poor feeding and reduced growth due to substandard water quality when the flows are low enough. When the river and tributaries dry to disconnected pools, salmonid survival is poor. Because the areas most affected by low-flow are some of the most important and favorable coho rearing habitat in the Mattole, addressing this problem is essential to survival of the species. Current dissolved oxygen, water quality, and low-flow monitoring is underway, and salmonid dive counts conducted, to monitor these at-risk salmonids. Water conservation and water storage in critical upper river and tributary oversummering habitat is crucial to preserve the viability of the best Mattole coho rearing habitat.

Temperature is important in determining the distribution and habitat utilization by juvenile coho in the Mattole Watershed, but other factors also play an important role. In addition to cool temperatures, tributaries where coho were observed in 2007 have other favorable salmonid habitat attributes in common, including the presence of riparian cover, pools, and habitat complexity provided by boulders and large and small woody debris. Lack of significant fine sediment and stream aggradation is also a common characteristic of streams where coho were observed in 2007.

Juvenile Chinook were observed in nine tributaries during dive surveys in 2007. These included Bear Creek (RM 42.8) and two tributaries of Bear, Jewett Creek (RM 42.8 + ~3.0) and South Fork Bear (RM 42.8 +~6.0), Big Finley Creek (RM 47.4), McKee Creek (RM 52.8), Upper Mill Creek (RM 56.2), Thompson (RM 58.4) and Yew (RM 58.4+~0.15) Creeks, and Ancestor Creek (RM 60.8). MSG staff also observed Chinook in the mainstem at seven D.O. monitoring locations in the upper Mattole (RM 59.4 – RM 52.1), at the Wingdam (RM 2.9), in the downstream migrant trap (RM 3.9) and in the Mattole Estuary. Current efforts to expand dive monitoring in the Mattole estuary, headwaters, and tributaries throughout the watershed aim to gain more understanding of the effects of elevated temperature and low streamflow on juvenile Chinook oversummer survival and distribution.

Temperatures recorded at the Mattole Estuary show oversummering salmonids encounter acute and prolonged thermal stress. Estuarine habitat does not support growth of rearing Chinook, and long-term survival of trapped salmonids once the mouth of the river is closed is questionable at best. In years where the mouth closes early, significant numbers of rearing Mattole Chinook perish in this bottleneck to survival of the species. Dive counts have confirmed the nearly complete decline of Chinook populations in the estuary over the course of the summer. Yearly salmonid population monitoring with concurrent multi-parameter water quality monitoring is recommended in order to effectively assess risks to the population from year-to-year and enact effective rescue and mediation.

Because of the seasonal and annual variability of mouth closure of the Mattole, it is essential for juvenile coho and Chinook survival that the coolest and best of the middle and lower Mattole tributaries are protected with reference to their favorable characteristics for salmonid oversummering.

Tributaries monitored in 2007 where temperatures reached short-term lethal maximum temperature for salmonid survival (>75°F, Brungs and Jones 1977) included the Lower North Fork (RM 4.7), Conklin Creek (RM 7.8), the Upper North Fork Mattole (RM 25.5) and Oil Creek (RM 25.5+~2.0). Characteristics common to these streams include a high occurrence of channel aggradation, a high percentage of grasslands and road density and/or slides in the subbasins.

Maximum temperature exceeded lethal temperatures for juvenile salmonids (>75°F, Brett 1952) in thirteen of fifteen temperature monitoring sites in the mainstem Mattole River downstream of river mile 47.4 (pool at Big Finley Creek). Sites where temperatures were did not reach lethal limits to salmonid survival in the lower mainstem included two cool refuges, the pool upstream of Squaw Creek (RM 15) and directly upstream of Stansberry Creek, one of the coolest lower river tributaries (RM 1.3). MWAT in fourteen of fifteen temperature monitoring locations in the middle and lower river showed unsuitable thermal habitat for all salmonid species.

More habitat enhancement structures in the middle and lower river and estuary would offer better oversummering habitat than now exists. Recent habitat improvements implemented by the MSG include large wood structures constructed in Squaw Creek and the Mattole Estuary. Deep pools, riparian cover, and cool-water tributaries are essential refuges for juvenile salmonids from unsuitably high temperatures in the lower and middle mainstem Mattole River during the summer months.

Recommendations

- Give monitoring and restoration priority to streams in which temperatures remain cold, yet coho are not present.
- Continue dive surveys to monitor Chinook and coho presence in creeks and mainstem locations throughout the Mattole Watershed over multiple study years to establish a baseline of salmonid habitat distribution in comparison to temperature trends.
- Continue monitoring temperatures, delineating specific goals for each logger placement.
- Implement pre- and post-project monitoring of restoration sites.

- Continue to study specific cold areas (pools and seeps), observing the dynamics of the channel morphology/temperature relationship through time. Expand cold-water monitoring sites in areas throughout the Mattole watershed.
- Continue temperature monitoring at Mattole mainstem and tributary reference locations.
- Expand tributary monitoring to more tributaries throughout the watershed
- Monitor temperature in critical upper mainstem rearing habitat, in addition to low-flow, dissolved oxygen, and other water quality parameter monitoring.
- Monitor coho, Chinook, and steelhead presence in the Mattole Estuary via dive surveys to determine survival, distribution, and abundance over the summer months.
- Conduct water quality investigations to elucidate water quality factors in addition to temperature affecting salmonid oversummering in the mainstem Mattole River and tributaries throughout the watershed.
- Utilize temperature data to determine areas where restoration activities can be conducted to enhance habitat in areas which support water temperatures favorable for salmonid oversummering.
- Enhance pool habitat in the middle and lower river to expand oversummering habitat for juvenile salmonids.

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Table 1. 2007 Mattole Salmon Group Temperature Monitoring: funding sources, serial numbers, location, and dates of placement. Date and value of recorded max temperature, days >68F, Maximum Weekly Average Temperature and week of are also provided in Table 1.

Serial #	Location	River Mile	Date In	juvenile salmonids, 1st snorkeling	Date out	juvenile salmonids, 2nd snorkeling	Max	Date	MWAT	Week of	Days>68	Total Days	Notes
626828	Mattole Estuary (upper) (shallow)	~0.5	5/22	KS, SH	10/3	KS, SH	79.48	7/23	78.07	7/23	121	132	5/16 and 10/2 estuary dive data
741054	Mattole Estuary (upper) (deep)	~0.5	5/22	"	10/3	"	79.61	7/23	78.17	7/23	121	132	5/16 and 10/2 estuary dive data
1001339	Mattole Estuary @ MSG Structure	~0.5	10/18	KS, SH	10/11	none	76.38	9/4	73.01	7/20	121	358	5/16 and 10/2 estuary dive data
1157767	Mattole Estuary (air)	~0.5	6/7	"	10/3	"	93.33	9/2	65.8	8/16	100	117	
893657	Lower Bear Creek	1+0.3	5/3	SH	10/11	none	60.99	8/21	59.08	7/20	0	160	found out of water, data after 10/3 discarded
895563	Stansberry Creek	1.3+0.1	5/3	none	10/11	SH	67.24	9/6	60.63	7/21	0	160	
309426	Mattole us Stansberry Cr.	1.3	5/28	N/A	10/1	N/A	68.97	7/23	62.39	7/21	2	125	spring location in river was backwater pool by fall
882012	Lower Mill Creek	2.8+0.1	5/3	SS, SH	10/11	SH	62.32	7/24	60.01	7/22	0	160	
575793	Mattole @ Wingdam (deep)	2.9	5/9	KS, SH	10/9	N/A	82.22	7/23	74.02	7/21	129	152	dive on 5/8
893658	Mattole @ Wingdam	2.9	5/8	KS, SH	10/9	N/A	81.86	7/23	73.83	7/21	131	153	
918955	Mattole @ DSMT	3.9	4/10	KS, SS, SH	10/4	KS, SS, SH	81.56	6/23	74.02	6/21	131	171	no dive, salmonids observed in trap
1157775	Lower North Fork	4.7+~1.0	6/11	SH	10/2	SH	81.2	7/23	70.88	7/21	105	112	
891613	Mattole us L. North Fork	4.7	5/28	N/A	10/1	N/A	80.76	7/23	74.22	7/21	112	125	
575775	East Mill Creek	5.4+~0.2	5/17	SH	10/6	SH	65.32	7/24	62.26	7/21	0	141	
882000	Mattole us East Mill Creek	5.5	5/28	N/A	10/1	N/A	82.44	7/23	74.52	7/21	113	125	
891511	Clear Creek	6.1+0.2	5/4	SH, UN	10/6	SH	63.09	7/24	60.59	7/21	0	154	
891576	Mattole us Clear Creek	6.1	5/28	N/A	10/1	N/A	83.15	7/23	74.5	7/21	117	125	
884733	Conklin Creek	7.8+0.3	5/4	none	10/11	SH	77.95	7/23	65.89	7/21	89	159	
575798	Mattole us Conklin	7.8	5/28	N/A	10/1	N/A	82.44	7/23	74.63	7/21	120	125	

	Creek												
1163387	McGinnis Creek	8.0+0.1	6/15	SH	10/12	N/A	70.5	7/23	64.27	7/21	14	118	
618860	Squaw Creek	14.9+0.1	5/2	N/A	10/11	SH	73.85	7/23	68.94	7/22	65	161	
1157774	Mattole us Squaw Creek	15	6/1	N/A	10/1	N/A	71.49	7/23	69.07	7/22	59	121	
900610	Woods Creek	24.1+0.1	5/1	SS, SH	10/6	SS, SH	65.73	6/23	61.65	6/22	0	127	logger faulty after 9/6
1157763	Mattole us Woods Creek	24.2	6/1	N/A	10/1	N/A	80.49	7/5	73.88	7/22	111	121	
1163382	Oil Creek (trib to Upper North Fork)	25.5 +~2.0+~0.1	6/15	SH	10/4	SH	79.83	7/5, 7/6	68.97	7/21	91	110	
891412	Upper North Fork	25.5+~1.0	5/2	none	10/4	SH	77.14	7/5, 7/6	69.3	7/22	105	154	
1157771	Mattole us U. North Fork	25.5	6/1	N/A	10/1	N/A	81.6	7/23	73.06	7/22	116	121	
688336	Honeydew Creek (lower)	26.5+~1.0	5/1	none	10/3	SH	72.81	7/1	65.45	6/22	64	126	data only until 9/6
1157765	Honeydew Creek (air)	26.5+~1.0	6/14	"	10/3	"	91.22	8/29	68.68	8/28	91	110	
1163383	Honeydew Creek (east fork)	26.5+~2.5+0.1	6/18	SH	10/3	SH	68.74	8/1	67.62	7/22	4	106	
1163389	Honeydew Creek (upper)	26.5 + ~2.5	6/18	SH	10/3	SH	67.11	7/6	62.85	7/22	0	106	
1157777	Mattole us Honeydew Creek	26.5	6/1	N/A	10/1	N/A	80.23	7/23	73.41	7/22	108	121	
1163385	Gilham Creek	32.8+~0.1	7/12	SH	10/4	SH	64.67	7/23	62.21	7/22	0	83	
575780	Fourmile Creek	34.6+~0.1	5/29	SH	10/4	SS, SH	70.54	8/1	65.08	7/22	39	127	
895564	Mattole us Fourmile Creek	34.6	5/29	N/A	10/4	N/A	81.24	7/23	75.5	7/22	110	127	
1163388	Sholes Creek	36.6+~0.1	7/12	SH	10/4	SH	66.43	7/23	62.38	7/21	0	83	
1163384	Grindstone Creek	39+~0.2	6/8	SH	10/11	SH	71.27	8/1	64.97	7/21	32	124	
1163386	Blue Slide Creek	42.0 +~0.1	6/22	SH	10/12	N/A	69.6	7/5	64.37	7/18	3	111	logger partially buried in fine sediment when retrieved
891582	Mattole ds Ettersburg Bridge	~42	5/14	N/A	10/8	N/A	79.26	8/1	72.05	7/22	101	146	
701105	Mattole ds Ettersburg Bridge (air)	~42	6/14	"	10/8	"	92	9/6	70.03	7/4	100	115	
989871	Bear Creek	42.8+~0.2	5/14	KS, SH	10/8	SH	74.42	8/1	68.89	7/28	55	146	
1163381	Jewett Creek		6/8	KS, SH	10/11	SH	65.4	7/23	61.67	7/21	0	124	

1157758	S. Fork Bear Creek	42.8+~6.0	6/14	KS, SH	10/17	SH	65.32	7/6	60.25	7/4	0	124	
1157762	Bear Creek us Jewitt Creek		6/8	N/A	10/11	N/A	71.4	8/1	66.51	7/28	40	124	
884753	Mattole us Bear Creek	42.9	5/14	N/A	10/8	N/A	80.71	8/1	73.17	7/22	110	146	
1163380	Deer Lick Creek	45.9 + ~0.1	6/22	SH	10/12	SH	66	7/6	61.88	7/22	0	111	
1157759	Big Finley Creek	47.4+~0.1	5/31	KS, SH	10/12	SH	62.36	8/2	59.8	7/23	0	133	
1157766	Mattole at Big Finley Creek	47.4	5/31	KS, SH	10/12	N/A	68.66	7/6	65.66	7/4	3	133	Freshwater mussels, lamprey redds +dead lamprey, newts, crawdads
1157756	Eubanks Creek	47.7+~0.1	5/31	SH	10/12	SH	64.8	7/25	61.21	7/22	0	133	
1157768	Mattole us Eubanks Creek	47.8	5/31	N/A	10/12	N/A	72.87	7/6	68.62	7/22	23	133	
575792	Bridge Creek	52.1+~0.1	5/27	SH	10/5	SH	65.96	7/6	61.47	7/22	0	130	
1157755	MS-6, Mattole us Bridge Cr	52.2	5/31	KS, SH	10/10	KS, SH	71.27	7/6	67.14	7/23	20	131	SS observed on 7/31 D.O. dive
688889	Mattole @ Junction Hole	52.7	5/25	KS, SH	10/5	N/A	67.93	7/6	66	7/23	0	132	KS and SH observed during Summer Steelhead Dive on July 15
895562	McKee Creek	52.8+~0.1	5/3	KS, SS, SH	10/17	SH	65.06	8/1	62.07	7/23	0	166	
1157760	Buck Sinkyone Creek	52.0+0.7	6/14	N/A	10/30	N/A	65.7	7/27	63.06	7/22	0	137	no salmonids due to barrier
989872	Van Arken Creek	54+~0.1	5/27	SS, SH	10/5	SH	62.75	8/1	60.51	7/23	0	130	
1157773	MS-5/Mattole us Van Arken Cr	53.8	5/31	KS, SS, SH	10/10	KS, SS, SH	71.36	7/6	66.12	7/23	22	131	dive data from D.O. dives on 7/31/07 and 9/20/07
891612	Upper Mill Creek	56.2+~0.1	5/27	KS, SH	10/5	SH	63.52	7/6	60.64	7/24	0	130	
1157772	Mattole us Upper Mill Creek	56.3	5/31	N/A	10/12	N/A	66	7/6	63.26	7/24	0	133	
575786	Mattole ds Metz Bridge	56.9	5/7	KS, SS, SH	10/12	SS, SH	66.56	8/1	63.58	7/24	0	157	
1157769	Mattole ds Metz Bridge (air)	56.9	5/31	"	10/12	"	80.05	7/5	63.97	7/3	61	133	
884719	Baker Creek	57.6+~0.1	5/27	SS, SH	10/10	SH	62.062	7/6	60.38	7/24	0	135	
1157770	Mattole us Baker Creek	57.8	5/31	KS, SS, SH	10/10	KS, SS, SH	67.16	7/6	63.2	7/27	0	131	dive data from D.O. dives on 7/23/07 and 9/20/07
575787	Thompson Creek	58.4+~0.1	5/25	KS, SS, SH	10/17	KS, SS, SH	64.25	7/6	61.51	7/24	0	144	

575777	Yew Creek	58.4+0.15+0.1	5/25	KS, SS, SH	10/17	KS, SS, SH	63.73	7/6	60.25	7/24	0	144	
1157761	Mattole us Thompson Creek	58.5	5/31	SS, SH	10/10	KS, SS, SH	64.33	7/6	61.35	7/24	0	131	fall dive data from D.O. dive on 9/20/07
893659	Helen Barnum Creek	58.9+~0.1	5/25	none	10/10	SH	57.68	7/29	57.32	7/29	0	137	
575774	Lost River	58.8+~0.1	5/25	SS, SH	10/30	SH	60.6	7/6	59.62	7/27	0	151	creek dry for ~ l00 feet us confluence, data discarded after 10/22, logger found out of water on 10/30
575781	MS-2/Mattole us Lost River	58.9	5/25	KS, SS, SH	10/10	SH	64.42	7/6	61	7/24	0	137	dive data from D.O. dives on 7/25/07 and 9/20/07
575782	MS-1, Mattole ds Big Alder Creek	59.4	5/25	KS, SS, SH	10/10	SS, SH	63.99	7/6	60.14	7/24	0	137	dive data from D.O. dives on 7/25/07 and 9/20/07
891552	Ancestor Creek	60.8+~0.2	5/25	KS, SS, SH	10/10	SS, SH	59.19	7/6	56.8	7/26	0	137	
1157757	Mattole ds Ancestor Creek	60.8	5/31	N/A	10/10	N/A	58.58	7/6	56.57	7/24	0	131	

Key:
MWATs colored RED are considered unsuitable for juvenile coho and steelhead presence. Coates et. al. (2002) found that juvenile coho and steelhead are unlikely to persist in areas where Maximum Weekly Average Temperatures (MWAT) exceeds 63.0- 66.0° F. PURPLE indicates temperature monitoring locations where MWATs exceeded the threshold for coho presence (63.0°F), but remained below the threshold for steelhead (>66.0°F). BLUE indicate temperature monitoring locations where MWAT was suitable to support coho and steelhead (>63.0°F).

Maximum Temperatures colored RED exceeded short-term maximum temperature thresholds (50% survival) for acute temperature stress to salmonids (>75.0°F).

N/A= not available, + denotes tributary mileage, LB= Left Bank, RB=Right Bank, us=upstream, ds=downstream

Table 2. 2007 Mattole Salmon Group Juvenile Dive Surveys in Association with Temperature Monitoring. Serial number, location, and dates of survey. Species and size class of juvenile salmonids observed and number of pools surveyed are provided in Table 2.

Spring Dives

Serial #	River Mile	Location	Date	person-nel	SH <4''	SH 4-8''	SH >8''	KS <4''	KS 4-8''	SS <4''	SS 4-8''	ND <4''	ND 4-8''	# Pools	Comments
626828	~0.5	Mattole Estuary (upper) (shallow)	5/16	J.G., S.J., M.G., J.H.	450	600	0	900	0	0	0	0	0	N/A	Estuary dive, Area #6
741054	~0.5	Mattole Estuary (upper) (deep)	5/16	J.G., S.J., M.G., J.H.	"	"	"	"	"	"	"	"	"	N/A	Estuary dive, Area #6
1001339	~0.5	Mattole Estuary @ MSG Structure	5/16	J.G., S.J., M.G., J.H.	0	300	0	800	0	0	0	0	0	N/A	Estuary Dive, Spot check at Structure
893657	1+*	Lower Bear Creek	5/3	M.R., A.B., J.S.	1	0	0	0	0	0	0	0	0	10	4 frogs, live & dead algae, fine coating of sediment on rocks, turbid
895563	1.3+0.2	Stansberry Creek	5/3	M.R., A.B., J.S.	0	0	0	0	0	0	0	0	0	10	no fish observed in 10 pools, 1" SH observed us
882012	2.8+0.1	Lower Mill Creek	5/3	M.R., A.B., J.S.	46	0	0	0	0	4	0	0	0	10	
575793	2.9	Mattole @ Wingdam (deep)	5/9	M.R., A.B.	48	25	0	23	0	0	0	0	0	1	dive on 5/8
893658	2.9	Mattole @ Wingdam (shallow)	5/8	A.B.	"	"	"	"	"	"	"	"	"	1	

1157775	4.7+~1.0	Lower North Fork	6/11	J.G., Otter	352	118	5	0	0	0	0	0	0	10	74 stickleback, 1 sculpin, 1 river otter
575775	5.4+~0.2	East Mill Creek	5/17	D.W., D.B.	192	11	0	0	0	0	0	0	0	10	
891511	6.1+0.2	Clear Creek	5/4	A.B., J.G.	56	1	0	0	0	0	0	2	0	10	
884733	7.8+0.2	Conklin Creek	5/4	A.B., J.G.	0	0	0	0	0	0	0	0	0	0	2 huge slides in upper Conklin Cr, one active slide ds loggers, loads of sediment
1163387	8.0 + 0.1	McGinnis Creek	6/15	J.G., N.Q.	373	10	0	0	0	0	0	0	0	10	
618860	14.9+0.1	Squaw Creek	5/2	A.B., J.G.	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0	no dive in Squaw this spring
900610	24.1+0.1	Woods Creek	5/1	J.G., M.R.	44	2	0	0	0	3	0	0	1	10	limited visibility, rainy, overcast
1163382	25.5 +~2.0+~0.1	Oil Creek (trib to Upper North Fork)	6/15	J,G., N.Q.	161	23	0	0	0	0	0	0	0	10	channel monitoring site, many tadpoles, 2 newts
819412	25.5+~1.0	Upper North Fork	5/2	A.B., J.G.	0	0	0	0	0	0	0	0	0	10	2.5' visibility, rained last night, yellow algae on rocks, SH in Longridge Creek

688336	26.5+~1.0	Honeydew Creek	5/1	M.R., J.G.	0	0	0	0	0	0	0	0	0	10	light drizzle, 12' visibility, yellowish algae on boulders, nothing seen
1163383	26.5+~2.5+0.1	Honeydew Creek (east fork)	6/18	J.G., N.Q., K.C.	278	6	0	0	0	0	0	0	0	10	channel monitoring site, rough skinned newt
1163389	26.5 + ~2.5	Honeydew Creek (upper)	6/18	J.G., N.Q., K.C.	207	3	1	0	0	0	0	0	0	10	start at 2nd pool us confluence of Honeydew Cr. With its east fork, channel monitoring site
1163385	32.8+~0.1	Gilham Creek	7/12	N.Q., J.P.	104	4	0	0	0	0	0	0	0	10	California newt, frogs
575780	34.6+ ~0.2	Fourmile Creek	5/29	J.G., J.S.	197	7	0	0	0	0	0	0	0	10	stickleback
1163388	36.6+~0.1	Sholes Creek	7/12	N.Q., J.P.	288	1	0	0	0	0	0	0	0	10	3 California newts, bedrock channel
1163384	39 + ~0.2	Grindstone Creek	6/8	J.G., N.Q.	146	3	0	0	0	0	0	0	0	10	rough skinned newt
1163386	42.0 +~0.1	Blue Slide Creek	6/22	J.G., N.Q.	189	0	0	0	0	0	0	0	0	10	channel monitoring site, crawfish, stickleback
891582	~42	Mattole ds Ettersburg Bridge	5/14	J.G., S.J.	5	0	0	0	0	0	0	0	0	1	

989871	42.8+ ~0.2	Bear Creek	5/14	J.G. S.J.	1133	0	0	98	0	0	0	0	0	10	
1163381	42.8+ ~	Jewett Creek	6/8	J.G., N.Q.	120	3	0	1	0	0	0	0	0	10	channel mnitoring site, sticklebacks
1157758	42.8+ ~6.0	S. Fork Bear Creek	6/14	J.G, K.C.	36	21	3	1	0	0	0	0	0	10	2 rough skinned newt, 1 pacific giant salamander, pool 2 had a 12" SH
1163380	45.9 + ~0.1	Deer Lick Creek	6/22	J.G., N.Q.	168	1	0	0	0	0	0	0	0	10	crayfish, channel monitoring site upstream
1157759	47.4+~0.1	Big Finley Creek	5/31	J.G., J.S.	70	21	2	7	0	0	0	0	0	10	crayfish, Newts
1157766	47.4	Mattole us Big Finley Creek	5/31	J.G., J.S.	50	15	0	2	0	0	0	0	0	1	Freshwater mussels, lamprey redds +dead lamprey, newts, crawdads
1157756	47.7	Eubanks Creek	5/31	J.G., J.S.	174	2	1	0	0	0	0	0	0	10	crawdads
575782	52.1+~0.1	Bridge Creek	5/27	M.R., A.B.	58	0	0	0	0	0	0	0	0	10	stickleback
1157755	52.2	MS-6, Mattole us Bridge	5/31	M.R., A.B.	29	0	0	6	0	0	0	0	0	1	2 lamprey carcass, 1 live lamprey
895562	52.8+ ~0.1	McKee Creek	5/3	J.G., M.G.	13	7	0	7	0	1	0	8	2	10	

989872	54+~0.1	Van Arken Creek	5/27	M.R., A.B.	39	0	0	0	0	1	0	0	0	10	
1157773	53.8	MS-5/Mattole us Van Arken	7/31	K.M., M.R., K.C.	202	8	0	5	0	3	0	0	0	1	D.O. Dive
891612	56.2+ ~0.1	Upper Mill Creek	5/27	M.R., A.B.	43	0	0	1	0	0	0	0	0	10	
575786	56.3	Mattole ds Metz Bridge	7/25	K.M., M.R., K.C.	34	14	0	20	0	12	0	0	0	1	D.O. Dive
884719	57.6+ ~0.1	Baker Creek	5/27	M.R., A.B.	48	1	0	0	0	71	0	0	0	10	
1157770	57.8	Mattole us Baker	7/23	K.M., M.R., K.C.	4	3	0	8	0	6	0	0	0	1	D.O. Dive
575787	58.4+ ~0.1	Thompson Creek	5/25	J.G., K.M.	246	26	0	17	0	23	0	1	0	10	SH- 232 yoy, 40 parr, lots of SH yoy, 2 newts
575777	58.4+ 0.15+0.1	Yew Creek	5/25	J.G., K.M.	5	0	0	10	0	87	0	0	0	10	SH- 3 parr, 5 yoy, lots of caddis flies
1157761	58.5	Mattole us Thompson Cr	5/31	M.R., A.B.	3	0	0	0	0	2	0	0	0	10	D.O. site, 92 SH yoy, 4 (4"-8") SH, 4 KS, 4 SS observed on 7/25
893659	58.9+ ~0.1	Helen Barnum Creek	5/25	M.R., A.B.	0	0	0	0	0	0	0	0	0	10	huge log jam ~ 0.25 miles us confluence, ~6' of impounded sediment

575774	58.8+ ~0.1	Lost River	5/25	M.R., A.B.	50	0	0	0	0	6	0	0	0	10	caddisflies, logjam @ base rerouted confluence, now adjacent to H. Barnum
575781	58.9	MS-2/Mattole us Lost River	7/25	K.M., M.R., K.C.	50	8	0	3	0	2	0	0	0	1	D.O. Dive
575782	59.4	MS-1, Mattole ds Big Alder Creek	7/25	K.M., M.R., K.C.	38	1	0	4	0	3	0	0	0	1	D.O. Dive
891552	60.8+ ~0.2	Ancestor Creek	5/25	M.R., A.B.	18	1	0	4	0	38	0	0	0	10	Mattole flow less than Ancestor flow, logger ds due to lack of flow us

Fall Dives

Serial #	River Mile	Location	Date	person-nel	SH <4''	SH 4-8''	SH >8''	KS <4''	KS 4-8''	SS <4''	SS 4-8''	ND <4''	ND 4-8''	# Pools	Comments
626828	~0.5	Mattole Estuary (upper) (shallow)	5/16	J.G., S.J., M.G., J.H.	5	30	1	1	0	1	0	0	0	N/A	Estuary dive, Area #6
741054	~0.5	Mattole Estuary (upper) (deep)	5/16	J.G., S.J., M.G., J.H.	"	"	"	"	"	"	"	"	"	N/A	Estuary dive, Area #6
1001339	~0.5	Mattole Estuary @ MSG Structure	5/16	J.G., S.J., M.G., J.H.	0	0	0	0	0	0	0	0	0	N/A	Estuary Dive, Area #3
893657	1+*	Lower Bear Creek	10/11	M.R., K.C.	0	0	0	0	0	0	0	0	0	10	1st 100' dry, > 6 juvenile yellow-

															legged frogs, 2 salamanders
895563	1.3+0.2	Stansberry Creek	10/11	M.R., K.C.	17	12	0	0	0	0	0	0	0	10	
882012	2.8+0.1	Lower Mill Creek	10/11	M.R., K.C.	125	2	0	0	0	0	0	0	0	10	
575593	2.9	Mattole @ Wingdam (deep)	10/9	A.B.	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
893658	2.9	Mattole @ Wingdam	10/9	A.B.	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
1157775	4.7+~1.0	Lower North Fork	10/2	J.G., K.C.	535	660	29	0	0	0	0	0	0	10	lots of stickleback, esp. juveniles, 2 12" SH (1 definite 1/2 lber. In pool 4
575775	5.4+~0.2	East Mill Creek	10/6	M.R., A.B.	25	0	0	0	0	0	0	0	0	10	creek dry at confluence, series of disconnected pools until bridge
891511	6.1+0.2	Clear Creek	10/6	M.R., A.B.	11	0	0	0	0	0	0	0	0	10	creek perched at confluence, but flowing
884733	7.8+0.2	Conklin Creek	10/11	A.B., J.B.	94	15	0	0	0	0	0	0	0	10	
1163387	8.0 + 0.1	McGinnis Creek	10/12	J.G., N.Q.	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

618860	14.9+0.1	Squaw Creek	10/11	A.B., J.B.	15	0	0	0	0	0	0	0	0	10	salmonids observed in backwater pool
900610	24.1+0.1	Woods Creek	10/6	M.R., A.B.	5	0	0	0	0	2	0	0	0	8	backwater pool us pool 3 newly discovered
1163382	25.5 +~2.0+~0.1	Oil Creek (trib to Upper North Fork)	10/4	A.B., K.C.	93	27	0	0	0	0	0	0	1	10	
819412	25.5+~1.0	Upper North Fork	10/4	A.B., K.C.	5	0	0	0	0	0	0	0	0	10	algae, dead algae in areas with lower flow, frogs
688336	26.5+~1.0	Honeydew Creek	10/3	J.G., K.C.	329	43	9	0	0	0	0	0	0	10	
1163383	26.5+ ~2.5+0.1	Honeydew Creek (east fork)	10/3	J.G., K.C.	3	0	0	0	0	0	0	0	0	10	1 UN <4" salmonid mort
1163389	26.5 + ~2.5	Honeydew Creek (upper)	10/3	J.G., K.C.	30	0	0	0	0	0	0	0	0	10	channel monitoring site, frog
1163385	32.8+ ~0.1	Gilham Creek	10/12	J.G., N.Q.	88	13	0	0	0	0	0	0	0	10	
575780	34.6+ ~0.2	Fourmile Creek	10/4	J.G., N.Q.	455	68	0	0	0	3	0	0	0	10	many small frogs, lots of stickleback
1163388	36.6+ ~0.1	Sholes Creek	10/4	J.G., N.Q.	95	4	0	0	0	0	0	0	0	10	newts +frogs
1163384	39+ ~0.2	Grindstone Creek	10/11	J.G., N.Q.	129	12	0	0	0	0	0	0	0	10	
1163386	42.0 +~0.1	Blue Slide Creek	10/12	J.G., N.Q.	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0	no dive, water murky, tea-colored

989871	42.8+ ~0.2	Bear Creek	10/8	J.G., K.C.	149	79	2	0	0	0	0	0	0	10	stickleback
1163381	42.8+ ~3.0 +~0.1	Jewett Creek	10/11	J.G., N.Q.	139	10	0	0	0	0	0	0	0	10	stickleback, kingfisher
1157758	42.8+ ~6.0	S. Fork Bear Creek	10/17	J.G., K.C.	29	20	0	0	0	0	0	0	0	10	
1163380	45.9 + ~0.1	Deer Lick Creek	10/12	J.G., N.Q.	50	3	0	0	0	0	0	0	0	10	mouth dry. Lower 260' of stream dry on 8/24
1157759	47.4+ ~0.2	Big Finley Creek	10/12	A.B., J.S.	37	6	1	0	0	0	0	0	0	10	
1157766	47.4	Mattole us Big Finley Creek	10/12	A.B., J.S.	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	no dive, water murky, tea-colored
1157756	47.7+ ~0.1	Eubanks Creek	10/12	A.B., J.S.	35	5	0	0	0	0	0	0	0	10	
575782	52.1+~0.1	Bridge Creek	10/5	M.R., A.B.	32	1	0	0	0	0	0	0	0	10	
1157755	52.2	MS-6, Mattole us Bridge	9/20	M.R., K.C., J.G.	45	0	0	1	0	0	0	0	0	1	D.O. dive
895562	52.8+~0.1	McKee Creek	10/17	J.G., K.C.	6	2	0	0	0	0	0	0	0	10	started survey at logger pool
989872	54+~0.1	Van Arken Creek	10/5	M.R., A.B.	1	0	0	0	0	0	0	0	0	10	1st time in 11 years internittent bedrock s solated pools
1157773	53.8	MS-5/Mattole us Van Arken	9/20	J.G., K.C., M.R.	16	8	0	0	0	0	0	0	0	1	D.O. Dive

891612	56.2+~0.1	Upper Mill Creek	10/5	M.R., A.B.	4	0	0	0	0	0	0	0	0	10	>20' visibility, great vis.
575786	56.9	Mattole ds Metz Bridge	9/20	J.G., K.C., M.R.	25	8	0	0	0	10	0	0	0	1	D.O.Dive
884719	57.6+~0.1	Baker Creek	10/10	A.B., J.B.	2	0	0	0	0	0	0	0	0	10	rained 3" last night but good visibility, lots of leaves though
1157770	57.8	Mattole us Baker	9/20	J.G., K.C., M.R.	11	5	0	1	0	7	0	0	0	1	D.O.Dive
575787	58.4+~0.1	Thompson Creek	10/17	J.G., K.C.	92	6	0	0	11	6	24	0	0	10	
575777	58.4+0.15+0.1	Yew Creek	10/17	J.G., K.C.	22	0	0	2	3	21	24	0	0	10	
1157761	58.5	Mattole us Thompson Cr	9/20	J.G., K.C., M.R.	33	5	0	1	0	5	0	0	0	1	D.O. dive
893659	58.9+~0.1	Helen Barnum Creek	10/10	A.B., J.B.	2	0	0	0	0	0	0	0	0	10	2 fish directly us confl., no fish above barrier
575774	58.8+~0.1	Lost River	10/10	A.B., J.B.	16	0	0	0	0	0	0	0	0	10	Lost River dry ~200' us confluence, snorkel survey ~200' us confluence to bridge
575781	58.9	MS-2/Mattole us Lost River	9/20	J.G., K.C., M.R.	21	6	0	0	0	0	0	0	0	10	D.O. dive, ~500' us Lost River confluence

575782	**59.4**	**MS-1, Mattole ds Big Alder Creek**	**9/20**	**J.G., K.C., M.R.**	**16**	**0**	**0**	**0**	**0**	**2**	**0**	**0**	**0**	**1**	**D.O. dive**
891552	**60.8+~0.1**	**Ancestor Creek**	**10/10**	**A.B., J.B.**	**2**	**0**	**0**	**0**	**0**	**1**	**0**	**9**	**0**	**12**	**poor visibility, to murky to see/ ID fish, rained 3" last night**