

State of California

The Resources Agency

Department of Fish and Wildlife

South Fork Trinity River 2015 Summer Temperature Report



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Introduction

The South Fork Trinity River is the largest tributary to the Trinity River above the confluence with the Klamath River. It's California's longest undammed river and has historically had the greatest numbers of Chinook in all of the Trinity River tributaries (LaFauce 1967). Drought conditions, which have persisted for four years, have caused Departmental concerns for the status of Spring Chinook salmon in the South Fork Trinity River. Low flows and increased temperatures are a serious risk to this unique population which is already at low threshold population levels. A summer temperature profile of the river could help explain why certain species of fish distribute themselves in the river during the summer months when the water is the lowest and temperature stress the highest due. It could also assist in the management of spring Chinook by locating cold water refugia, determine spawning distribution, and determine critical areas or time frames for protection. Fifteen Hobo temperature probes were deployed in the South Fork Trinity River beginning in June 2015. Additionally one probe was deployed in Forest Glenn in the shade of large tree above the river to monitor air temperature. Probes were set to record temperature every 30 minutes. Retrieval of the temperature probes began at the end of September and continued into November.

Study Area

South Fork Trinity River

The headwaters of the 627,200 acre South Fork Trinity watershed begin in the North Yolla Bolly Mountains (4,460 ft) and drain in a northerly direction for approximately 92 miles before joining the Trinity River near Salyer, California (460 ft.). It is the largest tributary to the Trinity River historically known for its dense timber and bountiful salmon population. Spring Chinook over summer in the South Fork and runs were estimated to be between 7,000 to 10,000 in 1963 and 11,000 in 1964 before the devastating 1964 floods reduced their population to the current annual average of 266 from 1990 to 2014. (Healey 1969, LaFauce 1967, Hill et al. 2016).

Methods

Temperature probes were deployed from above the East Fork of the South Fork down to Low Bridge, a couple miles above the confluence with the Trinity River. They span approximately 67 river miles and the majority of known adult Spring Chinook distribution (Figure 1). Water temperatures were recorded on 30 minute intervals by HOBO Water Temperature Pro v2 data loggers and placed at locations where the river water will hopefully continuously flow all summer. Loggers were housed in steel pipe structures and attached to larger structures in the river. Before deployment, loggers were submersed in an ice batch and compared to each other for calibration. Additionally all logger will be calibrated with respect to a NIST thermometer after sampling. All loggers were deployed by July 1st, 2015 and all were planned to be recovered by the end of 2015. One logger went missing due to unexpected riverbed manipulation and one couldn't be found.

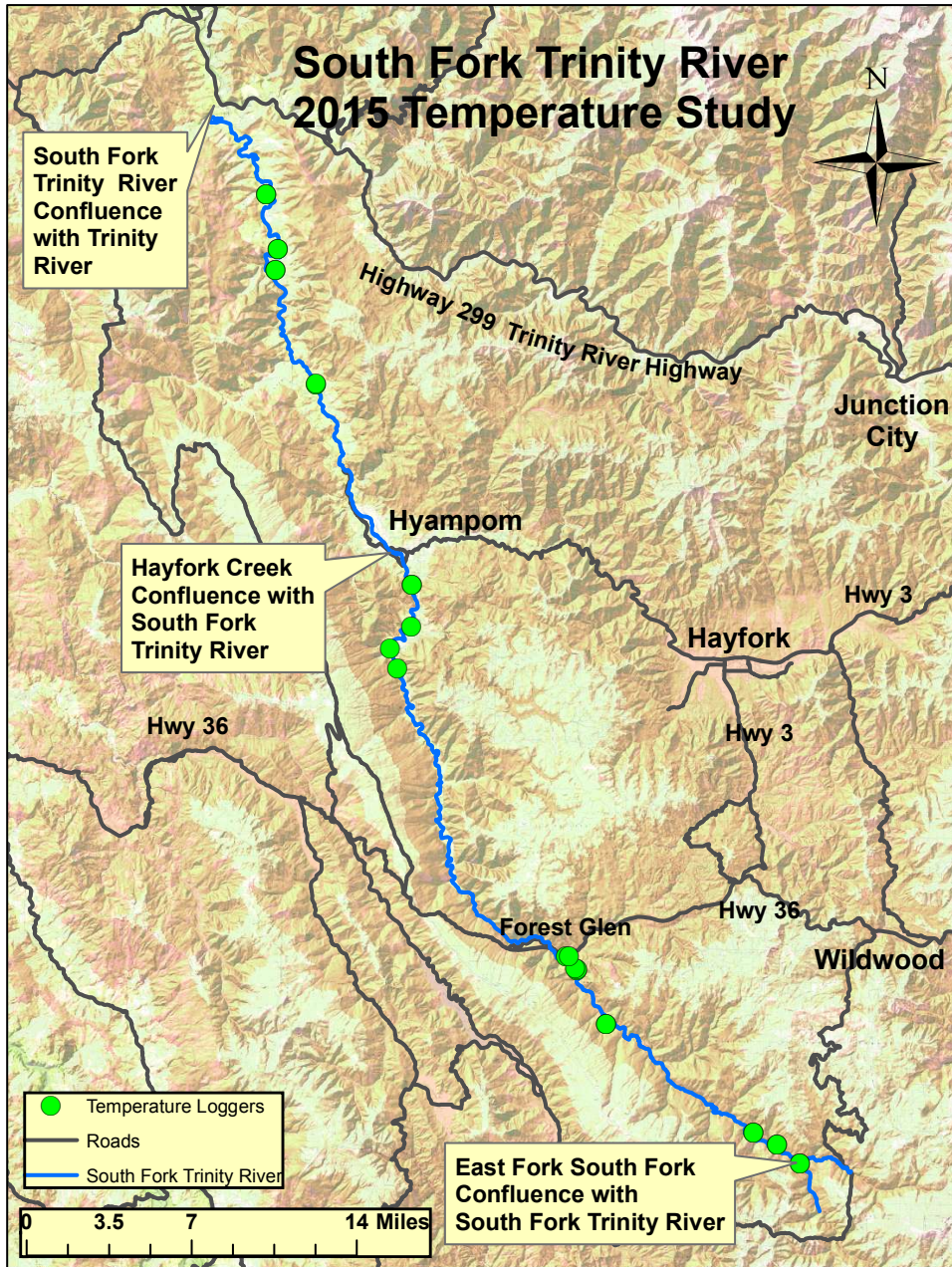


Figure 1. Map of South Fork Trinity River Study Area

Maximum weekly average temperature (MWMT) and maximum average weekly temperature (MWAT) were calculated from daily maximum temperatures and daily average temperatures for days with complete 24 hour intervals starting. In addition, the minimum weekly average temperatures were also calculated from daily minimum temperatures. These results were then categorized with respect to categories Garwood et al. established for the Smith River in 2014. These categories include cold (<15°C), cool (>15 and <16°C), warm (>16 and <18°C) and hot (>18°C).

Results

A table of all calculated MWAT and MWMT values accompanies the following figures in appendix 1. Overall, most of the river can be considered “hot” (>18°C) during the months of July and August according to categories established by Garwood et al. 2014 since both MWAT and MWMT values exceeded 20 degrees Celsius downriver from Scott Flat. The upper South Fork Trinity River above Scott Flat had MWAT values less than 20°C during the summer months, but no MWAT values below 16°C until mid-September indicating a “warm” category during the summer months (Garwood et al. 2014).

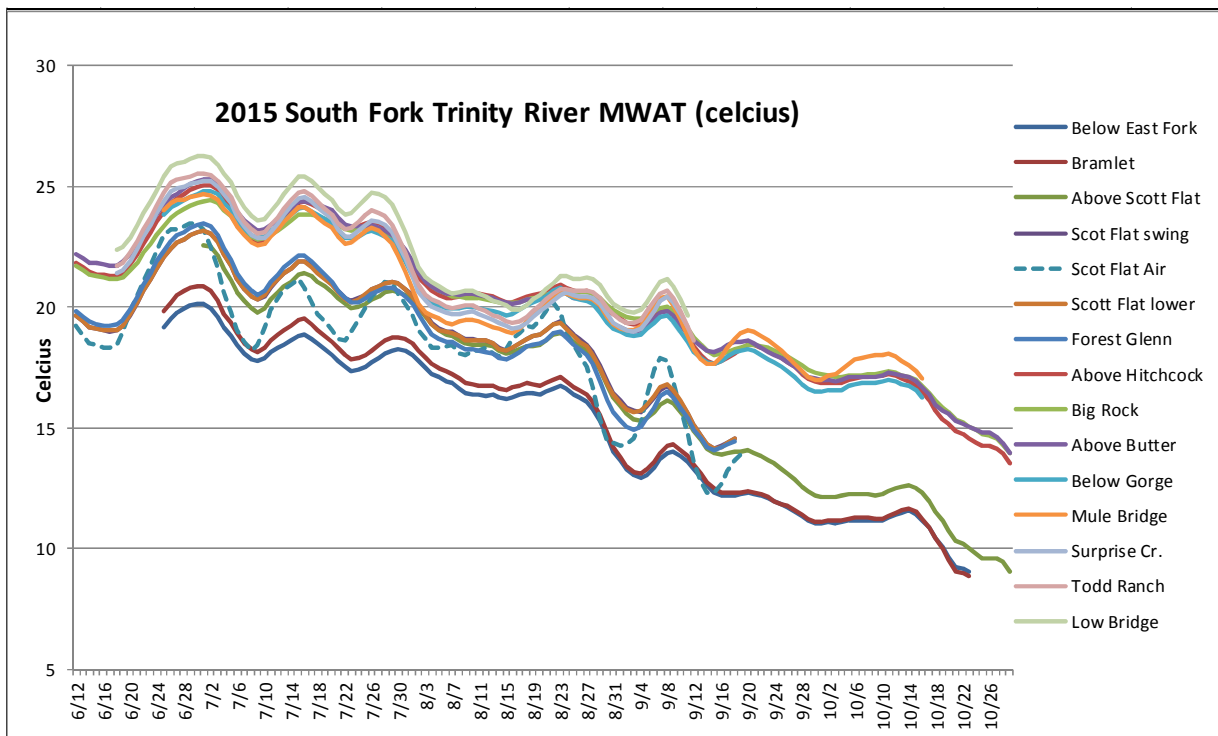


Figure 2. Continuous average of maximum average weekly temperatures during 2015, daily average temperatures averaged over seven day time periods.

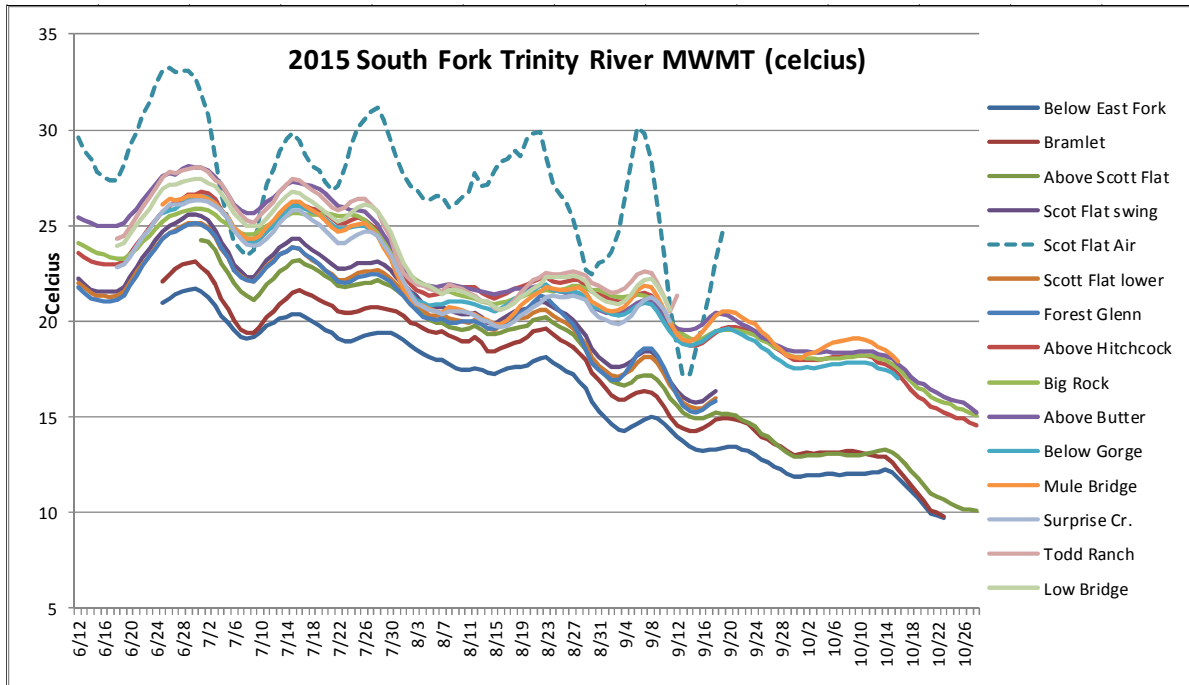


Figure 3. Continuous average of maximum weekly average temperatures during 2015, daily maximum temperatures averaged over seven day time periods.

Discussion

Like most rivers, water temperatures in the South Fork Trinity River generally increase as water flows down river. Temperatures in the river were the lowest between confluence of the East Fork of the South Fork Trinity River and Scott Flat. Water temperatures during the summer months of July and August below Scott Flatt have MWAT values greater than 18°C indicating a “hot” thermal category which could have deleterious effects on any adult salmonids present during that time. The 2015 California drought may be increasing these values higher than usual.

Flowing water temperature was the object of this project and temperature loggers were attached to the river in the thalweg of riffles and runs in attempt to measure the temperature of the water flowing downstream. This doesn’t take into account water temperatures at the bottom of deep pools where pool stratification occurs during the summer months. These deep pools are often where adult salmonids attempt to reside during the summer months, and future temperature analysis should be conducted to analyze how much thermal stratification occurs.

Table 1. Maximum MWAT and MWMT values in the South Fork Trinity in 2015

| Location | Maximum MWAT | Week Beginning | Maximum MWMT | Week Beginning |
|--------------------|--------------|----------------|--------------|----------------|
| Below East Fork | 20.158 | 6/30/2015 | 21.707 | 6/30/2015 |
| Bramlet | 20.892 | 6/30/2015 | 23.082 | 6/30/2015 |
| Above Scott Flat | 22.54 | 7/1/2015 | 24.25 | 7/1/2015 |
| Scot Flat swing | 23.161 | 7/1/2015 | 25.567 | 6/30/2015 |
| Scot Flat Air Temp | 23.49 | 6/29/2015 | 33.223 | 6/26/2015 |
| Scot Flat lower | 23.144 | 7/1/2015 | 25.162 | 6/30/2015 |
| Forest Glenn | 23.447 | 7/1/2015 | 25.1 | 6/30/2015 |
| Above Hitchcock | 25.061 | 7/1/2015 | 26.731 | 7/1/2015 |
| Big Rock | 24.416 | 7/2/2015 | 25.859 | 7/1/2015 |
| Above Butter | 25.308 | 7/1/2015 | 28.081 | 6/29/2015 |
| Below Gorge | 24.803 | 7/2/2015 | 26.525 | 7/1/2015 |
| Mule Bridge | 24.668 | 7/1/2015 | 26.546 | 7/1/2015 |
| Surprise | 25.247 | 7/1/2015 | 26.34 | 7/1/2015 |
| Todd Ranch | 25.561 | 7/1/2015 | 28.021 | 6/30/2015 |
| Low Bridge | 26.285 | 7/1/2015 | 27.45 | 6/30/2015 |

The above table displays the maximum MWAT and MWMT values for each location. None of these values are less than 20°celcius indicating that most of the river was in the “hot” category. To further the temperature understanding of the river, I additionally calculated all the minimum daily temperatures and then averaged them over seven day intervals similar to MWAT and MWMT to produce the following figure 4. Even plotting the minimum temperatures reveals that the bulk of the river was above 16°celcius during the summer months of July and August. The coolest areas in the South Fork of the Trinity River are between Scott Flat and the confluence with the East Fork of the Trinity River during summer of 2015 and the only areas with average minimum temperatures below 16°celcius.

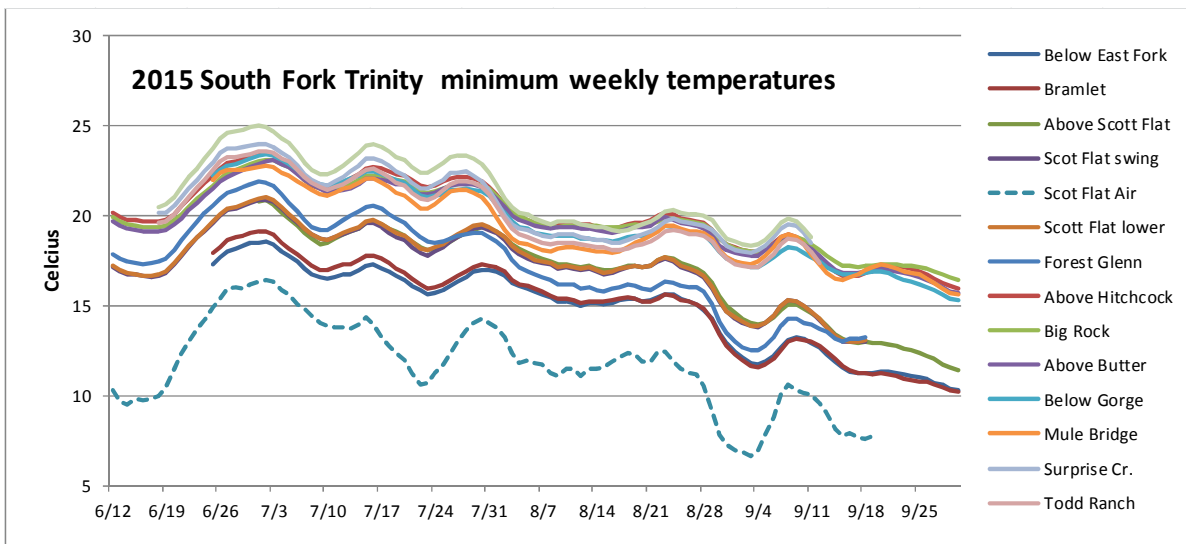


Figure 4. Continuous average of minimum weekly average temperatures during 2015, daily minimum temperatures averaged over seven day time periods.

Water temperatures in the South Fork Trinity River appeared to be limiting for cold water requiring fish such as salmon and steelhead during the summer months of 2015's drought. National Marine Fisheries Service considers optimal temperatures for adult Pacific salmon to be between 10 and 13.9°C and temperatures between 13.9 and 15.5°C put them "at risk". Egg size and development begins to be altered at temperatures over 17.5°C (McCullough 1999). Adult Chinook salmon have even been observed to die when temperatures exceed 21-22°C (McCullough 1999), and the critical thermal maxima for juvenile coho salmon according to Brett (1952) occurs at 24.4°C. A compounding stressor of higher temperatures on Pacific salmon is the increased virulence of fish diseases at temperatures over 15.6°C (McCullough 1999). All this indicates that the majority of the anadromous zone of the South Fork Trinity River was thermally stressful for Pacific Salmonids during the months of July and August during California's 2015 drought.

Recommendations

During the summer of 2015 all temperature loggers were planned to be deployed by July 1st. In analyzing the data, it appears there could have been temperature increases in June that were missed. One major recommendation is to deploy all temperature loggers by June 1st to attempt to catch any potential high temperatures which occur in June. Additionally, the monitoring of deep pool stratification could be performed during the summer months to see how much they are thermally stratified.

Literature Cited

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Appendices

| Appendix 1. Latitude and Longitude of all locations | | |
|--|-----------------|------------------|
| Location | Latitude | Longitude |
| Below East Fork | 40.255825 | -123.143851 |
| Bramlet | 40.262979 | -123.163025 |
| Above Scott Flat | 40.328101 | -123.282367 |
| Scot Flat swing | 40.361415 | -123.306334 |
| Scot Flat Air Temp | 40.361163 | -123.306575 |
| Scot Flat lower | 40.362542 | -123.307734 |
| Forest Glenn | 40.369422 | -123.315369 |
| Above Hitchcock | 40.5448 | -123.4546 |
| Big Rock | 40.557 | -123.4611 |
| Above Butter | 40.5704 | -123.4441 |
| Below Gorge | 40.595907 | -123.44429 |
| Mule Bridge | 40.718309 | -123.524191 |
| Surprise | 40.787916 | -123.558743 |
| Todd Ranch | 40.800656 | -123.556916 |
| Low Bridge | 40.834397 | -123.567309 |