

Central California Coast Steelhead Regional Temperature Study

Technical Review Panel (TRP) & Agency Representative Meeting

9am - 12:00pm, 11/19/21

Moderator/Presenter: Scott Dusterhoff, SFEI

Note taker: Katie McKnight, SFEI

Technical Review Panel

- Mike Deas, Watercourse Engineering, Inc. (Davis, CA)
- Nann Fangue, UC Davis
- Tony Farrell, Univ of British Columbia
- Peter Moyle, UC Davis (Emeritus)

Agency Representatives

- Kevin Lunde, SFBRWQCB
- Kristina Yoshida, SFBRWQCB
- Richard Looker, SFBRWQCB
- Bryan McFadin, NCRWQCB
- Katharine Carter, NCRWQCB
- Jessie Maxfield, CDFW
- Emily Jacinto, CDFW
- Sean Cochran, CDFW
- Nick Van Vleet, NMFS
- Brian Thompson, EPA
- Eric Dubinsky, EPA

Valley Water and consultants

- John Bourgeois, Valley Water
- Lisa Bankosh, Valley Water
- Lisa Porcella Valley Water
- Jen Watson, Valley Water
- Clayton Leal Valley Water
- Eric Olson, Valley Water

- James Downing, Valley Water
- Bassam Kassab, Valley Water
- Andy Deines, Exponent
- Susan Paulsen, Exponent
- Ethan Bell, Stillwater Sciences
- Matt Drenner, Stillwater Sciences

Meeting Agenda

Item	Time
1. Welcome and Introduction	9:00 - 9:20 am
2. Presentations on RTS Elements and Work to Date	9:20 - 10:20 am
3. Moderated Agency Discussion	10:20 - 10:50 am
4. BREAK	10:50 - 11:00 am
5. Moderated TRP Discussion	11:00 - 11:50 am
6. Next Steps	11:50 am - noon

1. Presentations on RTS Elements and Work to Date

Regional Temperature Study: Background and Status Jennifer Watson (Valley Water)

Jen gives a detailed account of the background of this project. Jen notes the water boards typically assess water quality data every two years to determine if they contain pollutant levels that exceed criteria to protect fish and wildlife. If historical or natural water temperature data are

unavailable, then temp evaluation guidelines can be used to determine suitable water temperature. When multiple beneficial uses exist, they must support the most sensitive use. Los Gatos Creek is recommended to be listed as temperature impaired relative to cold freshwater habitat and migration uses for Central California Coast (CCC) steelhead. Adopted proposed change in Oct 2020. Los Gatos Creek (LGC) listing based on EPA Region 10 water quality standard guidance based on multiple salmonid species in Oregon, Idaho, and Washington. The main point of this study is to determine whether these guidelines are ecologically appropriate for our region. Valley Water recommended undertaking a regional temperature study to take into account local adaptation to distinct population areas. This study is set to be completed in January 2023.

Central California Coast (CCC) Steelhead DPS is listed as threatened under the Endangered Species Act (ESA). The Range is from the Russian River to Aptos Creek. LGC is a tributary of Guadalupe River that drains to SF Bay.

The small sample size of steelhead in LGC was concerning. Valley Water wants to increase the sample size and range of habitats (temperature variability and response detection) so they are looking at a regional study area. A major question is whether the regulatory standards derived from the northern populations of steelhead are applicable to steelhead in the CCC DPS range.

Jen explains this project is currently in Phase 1. As part of the Phase 1 effort, Stillwater conducted a review of existing literature and data to determine the extent of available information. Stillwater is currently in the process of data acquisition and analysis to predict the probability of steelhead occurrences based on temperature. Valley Water has also contracted with SFEI to convene an independent TRP to assess data and make science recommendations for data collection and analyses that can help get to appropriate guidelines.

Phase 2 is still being developed. The expectation is that Phase 2 will include one or more of the following: natural and historical water temps (ref sites and modeling), additional field data collection (temp data, growth data), and experimental studies (stream-side aerobic scope, cardiac performance, CTmax, lab growth).

Potential challenges for Phase 2 will be acquiring permits to conduct these studies due to the status of steelhead in this area.

The main goal is to develop an approach for determining regionally appropriate temperature evaluation guidelines for supporting cold freshwater and migration habitat of CCC steelhead. We don't expect the guidelines to be in full operation come the end of the Regional Temperature Study, but we hope a framework will be created to implement these guidelines over time.

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Q&A with Jen:

Peter Moyle asks how other species of fish fit into this project because there are many fishes in the region that could be of concern. Will any effort be made to include some of these factors that these other fish need? Jen thinks that the beneficial uses focus is on the listed species and that typically cold designation looks at these anadromous species. Peter notes that if other species aren't monitored and managed, they could wind up in trouble.

Clayton asks if Peter thinks this will be beneficial to all species when looking at steelhead? Peter thinks it does, riffle sculpin are similar but have a slightly warmer temperature tolerance than steelhead so could be beneficial to look at as well.

Tony notes steelhead have been identified as an important part but also they are the canary in the coalmine, so to speak. The question becomes is the steelhead the canary in the coalmine in these ecosystems when it comes to fishes, which may be unknown. If the focus comes back to LGC and there are insufficient fish to study, then we have to move outside of that creek to obtain fish to study. How far can we move outside of that location?

Lisa Porcella (Valley Water) mentions that this same conversation that Tony brought up has been happening internally on how large they should go with the study area since LGC is one small stream which is why they are looking at the wider range of habitat conditions throughout that DPS. Lisa mentions they can go wider or narrower if the TRP thinks we need to. They'd like to hear TRP's input on this.

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A review of temperature guidelines used for 303d listing of steelhead streams in California

Susan Paulsen and Andy Deines (Exponent)

Showed the temperature evaluation guidelines, which were from the PNW: migration blockage, optimum growth, growth reduction, and lethal.

Recent Evaluation Guidelines Based on Steelhead

- **Migration Blockage (7DADM < 20°C)**
 - 7-day average daily maximum, March 1 - June 15
- **Optimum Growth (MWAT < 19.6°C)**
 - Maximum weekly average, March 1 - October 31
- **Growth Reduction (7DAVG < 17°C)**
 - Rolling 7-day average, March 1 - October 31
- **Lethal Number of days exceeding 24°C,**
 - March 1 - October 31



Lethal indicator was a count of the number of days in which the temperature exceeded 24 degrees C. Exponent wanted to understand how these guidelines were developed for the PNW and whether new guideline data could be calculated using the same methods but substituting data from our region.

The evaluation guidelines are described in EPA publication, an Analysis of Temperature study, and these studies cited other studies. They looked for and obtained as many studies as they could, traced back from the underlying citations to the original data and original methods. Susan provides an example to illustrate this point.

Example 1: There were 5 studies cited to come up with a temp for migration blockage and delay. This example can be traced to four original sources. *Coutant* suffered from duplication issues. *Major and Mighell* used Okanogan sockeye. *Strickland* evaluated ten tracked steelhead, but temperature data were not recorded in this study. *Fish and Hanavan* was a detailed anecdotal report from 1948. Susan goes on to explain, within this first example, the assumptions and methodological concerns that were used to get to these evaluation guidelines. Her group has created a report that details their analysis further.

The main concerns based on the review of supporting documents include:

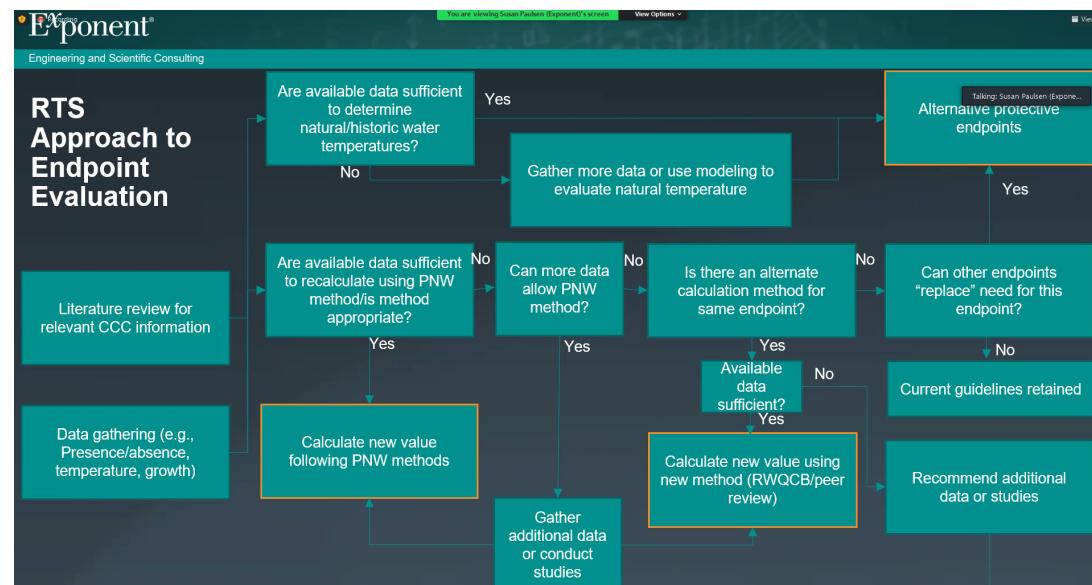
- Based on populations in historically cooler Oregon, Washington, and BC waters
- Few of the supporting studies deal with steelhead specifically
- Key studies lack modern acceptable rigor, and often based on long chain citations
- Substantial unaccounted for uncertainty around precise thresholds
- Do not consider evidence of adaptation

Can we apply Pacific Northwest (PNW) methods using CCC data to compute regionally appropriate guidelines? Susan discusses many concerns (see slides).

Can we apply PNW methods using CCC data to compute regionally appropriate guidelines?

- Three guidelines used data describing a lethal endpoint, at least in part (which cannot be replicated locally) [migration blockage, optimum growth, and lethal]
- Two endpoints had significant design, sample size, and/or statistical concerns [migration blockage and lethal]
- One endpoint used a complex bioenergetic model that might be difficult to replicate locally [growth reduction]
- One endpoint utilized a defensible method but arbitrary parameter selection [optimum growth]

Exponent's endpoint evaluation approach



Susan recommends discussing alternative protective endpoints and the need to calculate new values using new methods (RWQCB/peer review). Do they need all of the endpoints discussed? Do they need additional or different biological endpoints? Once they figure out the endpoints, what methods and data do they need to compute the guidelines? What units should the endpoint values be expressed in? Susan lists many questions for the TRP.

Kevin asks when non-TRP members can have access to the Exponent Report referenced in this talk. Susan said that their report has been submitted to the State Water Resources Control

Board and she thought it was shared with SFBRWQCB, so it is available now if they would like to review it.

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Q&A with Susan:

TRP is given the chance to ask questions.

Tony Farrell likes that Exponent traced back and analyzed the citations because blindly trusting citations is a common problem. The two key issues Tony wants to consider are local adaptation and thermal acclimation, as they are two mechanisms well demonstrated in the field of fish biology. Susan and Tony discuss what endpoints would be protective of these species and that we need to pick endpoints that we can derive appropriate values for. Can we just collect local data but use the same methodology? That's why they traced the citations. Tony thinks that the world "optimal" can have steep and flat curves, but the point is in a winter, steelhead trout have suboptimal temperatures, so is that bad? Steelhead have evolved to deal with a range of temperatures, and it can be optimal for some part of their life but perhaps not all of it. Optimal temps may vary based on the time of year. Tony suggests we move to some percentage of the confidence interval around the optimal temperature and suggests we need to include that as part of the thinking in determining appropriate endpoints. Tony also asks the question if the issue of methodology (i.e., endpoints) should be resolved before the TRP is asked to suggest appropriate experiments. In other words, does the TRP need to abide by the endpoints that are already part of the guidelines or can they recommend different endpoints?

Scott opens the Q&A discussion to others on the call.

Katharine (RB1) suggests looking at all parts of temperature objectives, which include temperatures altered from natural background conditions. Katharine notes that the first step is to determine if there have been alterations of stream temperatures and to include that in the assessment. She says that RB1 focuses on endpoints from the EPA guidance, MWMT. She says optimal is highly limiting. Susan responds by saying that it is unclear how you evaluate natural receiving water temperatures in a highly altered system; how to you evaluate temperature compared to a stream that would have been historically dry in the summer? Katharine thinks this is an important point and that this is something that RB1 has dealt with. Katharine thinks we should start speaking more globally if the intention of this study is to cover the full DPS (e.g., Russian River watershed). She also supports the idea of this study focusing on just Valley Water streams.

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Central Coast California Steelhead Temperature Tolerance Studies
Matt Drenner (Stillwater Sciences)

The ultimate goal is to provide info that will support appropriate guidelines to support CCC steelhead.

- Research Objective- Characterize temperature tolerance and limits for CCC steelhead
- Research Questions - Is there sufficient existing data/studies for evaluating the tolerance of CCC steelhead? What additional studies might be needed?

They have conducted a focused literature review, reached out to many local government agencies and water agencies to see what data is available, and started analyzing data.

For the literature review, they looked for studies specific to CA on steelhead life stages, etc. They looked at peer-reviewed studies in addition to agency reports. Lots of peer-reviewed studies were available and 9 or 10 agency reports as well. They were able to find 6 peer-reviewed studies looking at temp and thermal tolerance for CCC steelhead. There are many reports that show evidence that steelhead can tolerate and benefit from temperatures above 18 C. Commonly observed at 22 and up to 26 C.

They reached out to local water districts, regulators, academics, etc. who are doing research on this to find additional data. Matt shows a very long list (e.g., Napa River RCD, Marin Municipal Water District). Everyone they spoke with was very supportive of this effort and provided data. Their goal was to relate temperature collected to steelhead life stages.

Data Identification/Collection

Santa Clara Valley Water District

Santa Clara Valley Urban Runoff Pollution Prevention Program

Sonoma County Water District

East Bay Regional Parks District

East Bay MUD

Marin Municipal Water District

Napa River RCD

San Francisco PUC

San Mateo RCD

Regulators: CDFW, NMFS

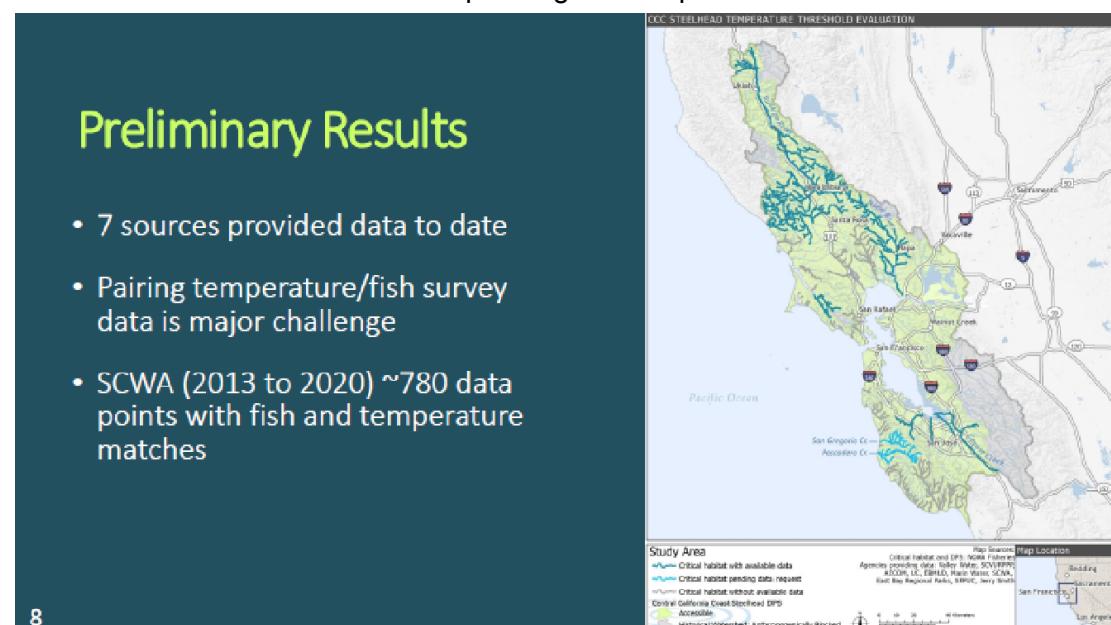
Academics: San Jose St., UC Davis, UC Berkeley, UCSB

Survey data for *O. mykiss* (steelhead and resident rainbow trout) were obtained. There is a lot of continuous temperature monitoring data where *O. mykiss* live. There is a lot of movement data like telemetry that could be useful. There was limited data on growth, prey availability, and

survival. They propose for Phase 1 to take advantage of fish survey data and continuous temp monitoring data.

Phase 1 study analysis goal is to predict the probability of *O. mykiss* occurrence based on temperature, which has been done in the past to support determination of suitable temps. Matt shows a hypothetical figure to show what to expect when comparing temperature to probability of occurrence, with a drop off in occurrence after an optimal temperature threshold is surpassed. This will allow them to develop tolerance ranges and potentially upper limits. They hope to evaluate intraspecific variability within CCC steelhead DPS. This study cannot come up with optimum temperatures.

Matt mentions that the preliminary results include 7 sources that provided a lot of data to date, which he thinks is very exceptional. He shows a map of the Russian River, Napa River, and Coyote Creek and other tributaries that have data. The gray creeks shown do not have data. There are also several creeks with pending data requests.

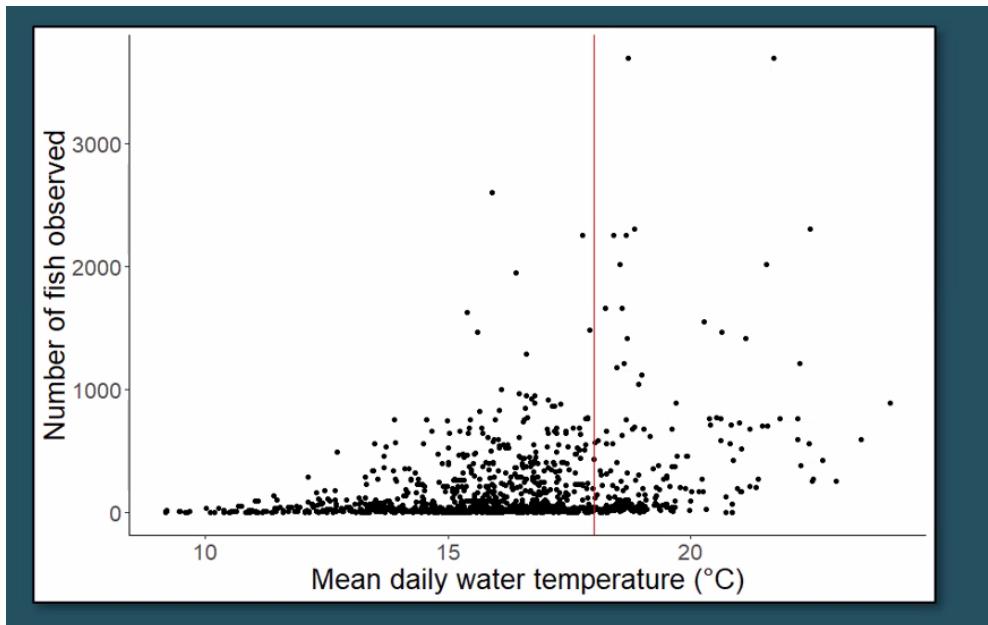


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Their next goal is to pair temperature data with fish survey data, but this will likely be a major challenge because they don't always overlap spatially and temporally because there were different goals to the data collected. They have to determine when it is appropriate to pair temperature and fish survey data based on collection time, distance between collection sites, etc. They currently have ~780 data points with fish and temperature matches between 2013 to 2020, but they are still working on filtering these data down to appropriate pairing.

Matt discusses preliminary results of these data to show what some of the takeaways may look like. Based on data exclusively from Sonoma County streams, on the days when *O. mykiss* survey occurred, they see a range of 8-27C (instantaneous), min daily avg 9C and max daily avg 24C. He shows this graph of same-day fish survey and mean daily water temp. Even when

temperatures are higher, they are still seeing *O. mykiss* are present and in some cases in very high occurrences. It's not statistically backed in the below example but shows some indication that these fish can tolerate the upper thermal limits for things like growth. However, this doesn't tell us what temperatures are considered optimal.



Limitations include measured temperatures versus realized temperatures due to microthermal refuges that may be available to *O. mykiss*. There are not a lot of data where fish are absent in the survey data (so not getting a lot of 0s in the datasets), so they may not be getting at upper lethal limits based on the dataset provided. Permits are also not given out at certain times so that could impact the data available. Habitat info is limited at these sites, but a few datasets do provide this info; large sample sizes and sampling across habitats with variability will help with this. There is also a lack of info on prey and competition, and we know this is a very important factor; large sample sizes can also help with this. They are getting large sample sizes that incorporate variability across the DPS. It would be nice to have a large, similar dataset for northern populations to compare with these data.

Implications for Phase 2 include:

- Characterize temps in rivers where *O. mykiss* occur
- ID study populations/sites
- Leads to focused studies to test why fish can/can't occupy these

Next steps include data collection (ongoing), data analysis (winter 2022), and reporting (spring 2022).

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Q&A with Matt

Scott goes over questions in the chat.

The 2020 paper (memo) encompasses the lit review and makes recs on how to approach these issues, but the actual data analysis they are currently doing will be presented in a pending paper.

Scott gives the TRP a chance to ask questions.

Mike asks, in his last slide he mentions it would be interesting to look at northern populations but did you look at data south of Los Gatos Creek? It might expand Matt's dataset. Matt mentions they have been discussing that and that they have done a literature review in that southern range. They haven't collected data yet in this southern reach but they have discussed that possibility. It is a lot of work to collect that data so TBD if they will do it.

Ethan mentions if there is a local adaptation temperature, it may be more pronounced in the south, but it might not answer their questions specifically for this DPS. Their concern is that it would answer a question but it would not specifically apply to management in this DPS.

Mike acknowledges it may be outside their scope but it could help in this discussion.

Peter wants to know how the non-steelhead *O. mykiss* are treated in the studies Matt talked about. How are they distinguished from steelhead? Matt mentions that in the data they provided, they cannot distinguish between an *O. mykiss* that is anadromous and a resident individual. They might be making the assumption that temperature tolerance is similar but they may not have the data to address this. They have been provided Jerry Smith's data, which is something Peter asked about.

Tony says he really likes this approach because it speaks to what these populations actually do. If you are overlaying different watersheds as you have done in that abundance graph, you should consider presenting it as normalized values to the abundance of a particular watershed. This will be important for LGC because there are so few fishes there. Tony asks how this approach separates out avoidance of temperature as a normal part of life history strategy because we know that fishes do avoid certain temps as part of a normal life history? This summarizes it but it doesn't give causative information. Matt agrees that this may be something that they can include in future studies to show what is available and include that with movement data. With the current analysis they cannot address that.

Scott highlights Richard's question in the chat. Richard asks, Stillwater report repeatedly refers to 7-DADM of 18C, but SF Water Board used 20C for this metric. Why the mismatch? Matt says that 18C was a general number that was thrown around previously but moving forward they will correct that.

Kevin asks if they've approached NOAA and CDFW for data and Matt confirms that they have.

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2. Moderated Agency Discussion

Scott gives the agency folks on the call a chance to express their thoughts with 6 minutes for each participant, starting with SFBRWQCB and then the other water board will have a chance to talk.

Scott invites the SF Bay Regional Board to speak.

Kevin Lunde and Kristina Yoshida speak first. Kevin starts out by reiterating the 4 temperature guidelines that were used for Los Gatos Cr that came from the PNW. Kristina reiterates the four evaluation guidelines for the previous listings, which include lethal and chronic types. Kristina goes over each life stage and corresponding temperature (see screenshot below). Kevin mentions that it would be helpful to see a literature tracing for Sullivan 2000 and whether they used steelhead populations from local populations. The RWQCB would like to see more endpoints considered, such as disease. He also points out it's very important to think about spawning as a beneficial use, which was not applied to LGC, but it will be applied to many other water bodies within the CCC DPS if that is going to be the study area. Another point to consider is that the SF Bay RWQCB used EPA numbers of 20C for 7DADM (migration) --- there is the choice to use 18C and 16C. They didn't use them because of factors unique to LGC, but these should be considered for other parts of the DPS. Kevin also asks that the RTS workplan is updated so that it is clear that the RTS is just about setting up an approach for updating guidelines and it is not the effort that will lead directly to a decision about the Los Gatos Creek temperature impairment listing.

Evaluation Guidelines

Type	Life History Stage	Metric	Threshold	Period	Source
Lethal		% days	24°C	Mar 1 – Oct 31	Carter 2008; Moyle 1976; U.S. EPA 1977
Chronic	Migration	7DADM	20°C	Mar 1 – Jun 15	U.S. EPA 2003; Shapovalov and Taft 1954
	Juvenile rearing & growth	7DAVG	17°C	Mar 1 – Oct 31	Sullivan et al. 2000
	Juvenile rearing & growth	MWAT	19.6°C	Mar 1 – Oct 31	Sullivan et al. 2000

Richard mentions some clarifications that are needed in the workplan. He also mentions that there are ways to get to a box in Figure 1 flow chart that says, “deriving alternative protective endpoints” and they would disagree with the notion that the Regional Board could derive alternative protective endpoints through understanding historical water temperature. The Regional Board still needs info (biological endpoints) on what are the protective water temperatures for steelhead. He recommends that item be removed from the flow chart shown or clarified. Richard also mentions something Katharine brought up in the comments, that beneficial use protection doesn’t rely on what a fish species can tolerate. It’s about the fish thriving. The Regional Board won’t be able to derive temp evaluation guidelines based on occurrence data (which points to tolerance).

Scott invites the North Coast Regional Board to speak.

Bryan McFadin speaks first for North Coast RWQCB. He reiterates that using presence and absence doesn’t signify fish health. Yes, those studies are enlightening and can be used as one line of evidence, but they don’t give us info on the health of the populations, just what they can tolerate. If the temps aren’t natural, there has to be evidence of no adverse effects to beneficial uses, and presence/absence data don’t tell us about that.

Katharine mentions she’ll discuss only things she agrees with. Katharine thinks this study needs to consider the most sensitive life stages, like eggs, emergence, juvenile rearing, and SPAWN beneficial use – even if it doesn’t occur in LGC. Take into account optimal can be used to indicate not necessarily temps we set something at, but look somewhere in the middle of optimal and tolerance. She agrees with Richard and Bryan’s points that presence/absence is not indicative of beneficial use protection. Look at availability of thermal refugia that affects

presence/absence; temps that cause disease and decrease DO weren't listed as possible factors to consider for suitable temperatures for CCC steelhead but are factors that cause stress. Need to also think about egg survival. Katharine agrees with the need and use of multiple indicators, and she doesn't think they need to pick one. They use lethality and max temp.

Scott invites CDFW to speak.

Sean Cochran from CDFW thinks Stillwater's work is great and there is a good list of collaborators. Mentions he has some data available for Stillwater to incorporate into their Phase 1 analysis. He also thinks it would be helpful for Stillwater to sit down with CDFW staff (e.g., Sean, Emily Jacinto, etc.) and look at Stillwater's data sources to see if there is anything they missed (they review all scientific research permits). Sean also mentions that he deals a lot with CCC Steelhead in lagoon habitats, monitoring coastal estuaries and bar-built lagoons. Will these temperature studies include those habitats? Matt responds that so far no, they are not and they can explain why. Sean responds that the stream habitats are very different from the lagoon habitats.

Scott invites NMFS to speak.

Nick Van Vleet from NMFS echoes previous comments on presence doesn't indicate fish thriving, and appreciates the limitations that Matt mentioned, such as that there can be cold water seeps providing microhabitats. He thinks sentinel cages could be a useful study to do. He mentions other considerations he would recommend such as survival as a key factor, the effects of disease, and smoltification impairment. He thinks these should be considerations for suitable temperature.

Scott invites EPA to speak.

Brian Thompson from EPA asks about the process for providing comments as the temp study and resulting documents develop. Will they have the opportunity to give comments? Scott responds that yes but we are still figuring out what this process will look like.

Eric Dubinsky notes there is a lot to be done to narrow the focus and he's looking forward to how this effort develops.

Scott opens the discussion to all participants.

Kevin Lunde notes it will be helpful to get a better focus on what the workplan really is. Is it about guidelines or identifying data gaps to get to evaluation guidelines? He thinks this is a fundamental question to figure out how far this process is slated to get in our two-year timeline. Valley Water and SFEI need to hone in on these inconsistencies in the workplan. Also, it would

be helpful to have more time (than two weeks) to review documents in advance of meetings or giving comments to the TRP.

Tony Farrell found it helpful to hear the regulatory perspective. He brings up the word "tolerance" and how he probably uses it differently than the regulatory agencies. There is a low end and a high end where fish cannot survive; can suffer or thrive within a zone of tolerance. He considers a fishes' tolerance as a period in which fish can resist an upper threshold for a period of time, but then will succumb to it. He cautions us to be careful when using the word tolerance since there is a period of thriving and suffering that is possible. He is hearing that upper limits for temperature tolerance are not good enough and wants to make sure the language is not confused. Fish move and spread out through upper and lower limits of tolerance. He hopes they can get on the same page moving forward. Scott defers to the fish biologists to figure out how to make this a consistent term throughout the study.

Jessie Maxfield (CDFW) asks if the TRP will weigh in on the appropriateness/inappropriateness of the existing guidelines. Scott responds that they probably will but it is not in their charge at this stage to give feedback on the guidelines per se and rather focus on the state of the science, data availability, and recommendations. Scott also brings up Tony's point from earlier that the endpoints or the methodology needs to be worked out for studies to be done, or the TRP needs to say what is important and that they can inform the endpoints. Need to figure out which comes first. Jessie says from the regulatory perspective it is important to understand why the current numbers don't work as opposed to what would work.

Scott highlights Katharine's question in the chat about whether the TRP has questions for the regulatory agencies.

Scott asks the TRP if they have questions for the Agency Representative.

Peter asks how rigid are the temp standards that NMFS or CDFW would set? He notes that since there is already EPA guidelines, is there enough flexibility that the temp guidelines could be changed based on new info? Richard responds by saying they have a water quality objective in the Basin Plan that references historical water temps and beneficial uses; since there aren't historical data, they focus on beneficial use protection but there is no number in their regulatory document. Instead they look at outside sources for a narrative regarding COLD and MIGR beneficial uses. That numeric interpretation of a narrative can be objective and dynamic so, yes, there is flexibility here and they can react to new info following this study.

Scott also brings up Richard's comment in the chat about the suggestion for lagoon or estuary habitats is a good idea. There is currently a push by USEPA in comments to CA waterboards to use SF Bay temperature data evaluated against the PNW guidelines (migration) in the context of determining impairment. So - if this study does not take that on, that is a potential missed opportunity.

Eric Dubinsky wonders if the DPS is an appropriate set of boundaries? Genetics may not line up. He thinks that the scope needs to be better defined; maybe TRP has more insight on how that should be developed.

3. BREAK (5 min)

4. Moderated TRP Discussion

Scott kicks off the discussion by clarifying that Year 1 is called Phase 1 and Year 2 is called Phase 2. However, likely all the info needed won't happen in those 2 years, so one of the tasks of the TRP is to determine studies that need to happen after this 2-year time period ends. Today we're just talking about Phase 1 (in process) and some ideas about Phase 2.

Scott also goes back to Tony's earlier question of whether the endpoints will be resolved before TRP does its work, or whether the TRP will first say what they think they should focus on as endpoints and then we develop study ideas.

Scott asks each TRP member to provide their initial thoughts.

Mike Deas: Timeframe is a challenge. There seems to be a need for specific information, and when you consider the uncertainty (e.g., realized temperature) and the paucity of appropriate data, there are some major challenges. Mike thinks there is a balance. Considering the degraded habitats involved, sees real challenges with beneficial use in some of these habitats. Should we invest in highly degraded areas or places in which there would be more benefit? He likes to think about a four-stage process. What do we need for good habitat quality? Need to think about where and when as well. For example, if we only look at Nov 1 through March 31, are temps good or is there an issue? He encourages us to break this apart into pieces and take some time to prioritize management actions. He cautions against spending too many resources in areas that are easily accessible but highly degraded. LGC is just a migration corridor (for now, maybe not forever). Can we start with what works and set aside other factors for now? How do we filter down to the important factors?

Kevin in the Chat to after Mike's comments - When developing evaluation guidelines or numeric water quality criteria The Water Board doesn't consider priorities in terms of where to take or ask for actions to improve water quality. So where to spend the dollar depends on many factors and occurs at totally separate and subsequent regulatory steps like issuing permits.

Nann Fangue echoes the importance of consistency in terminology and metrics that are used in the study and how we think about it as a group. Tolerance is a good example. This is going to be fundamental. Need to think about the right methods to set criteria, and also the notion that there are a lot of metrics we could evaluate but some are more suitable to give us an indication on lethality, for example. Lethality is a very crisp number (and this can be useful because guidance is a crisp number), but then we have these other metrics that are less of a specific number. Growth parameters play out over weeks to months and CTmax plays out over a few hours. We need to make sure what the literature says matches the guidance. This is both a challenge and exciting. Nann also reiterates the population and scales of latitude comments from earlier. She notes there won't be a silver bullet of one metric, and it may not matter whether it is northern or southern population, but rather the comparative metrics across populations. She wants us to keep in mind that a northern steelhead may have a different growth parameter in relation to temperature than southern steelhead and the direction of those differences is important to say whether a particular population is locally adapted. There may be some metrics we want to measure related to specific populations/streams, whereas there may be other metrics relevant to more broad populations/regions on a larger scale. Nann also mentioned that fish conservation is fundamentally what we're doing this for and each agency may need to think about what this means to them and that may be an important discussion at some point.

Tony Farrell's three messages include, (1) he's not sure how much the Australian-origin rainbow trout paper has been considered in this study, but it will be appropriate to get an idea of providing the metrics that Nann mentioned. The study shows rainbow trout tolerating temps up to 28C in the hatchery and are still growing well at 23C. At 25C the growth rate starts to fall off. So, that shows there is new evidence coming in on top of a very limited database specific to the local populations. (2) Thermal acclimation is a well-established mechanism. Two TRP experts have studied this intensely. It creates a new physiological phenotype, which tends to do better in new acclimation environment, but there are limits to acclimation so what are those limits? Are they suffering or thriving? That acclimation doesn't deal with diurnal fluctuations or perhaps taking advantage of cold-water inputs into streams, nor does it account for the acclimation process that is typically a three-week process to get there fully, but the arctic charr, for example, moves from arctic ocean into freshwater to survive winter. They have to go through fairly warm streams which may take 3 days to migrate, which is a very demanding migration. They can accomplish a lot of thermal acclimation in just 3 days. This changes the scientific knowledge base. (3) Adaptation. Adaptation is a real genetic change compared to acclimation. Redband trout are a good example. They have naturally evolved to live in the desert environments of Idaho and Oregon. Researchers in Idaho studying this are providing exceptional genetic, physiological, and molecular data to show this group of *O. mykiss* is thriving in desert

environments. Tony is bringing this to the table and we should consider this information as we move forward.

Scott asks if there are any considerations Tony has for the Phase 1 studies. Tony says measuring weight, girth and mass could be layered onto temperature data and abundance data to speak to the issue of fish health.

Scott reiterated Tony's comment about normalizing the data across watersheds. Matt weighs in by saying Valley Water has been evaluating fish condition in the way Tony discussed. In the chat Jen notes she can share these reports with the group. A lot of the survey data Stillwater collected doesn't have the length and weight data to go along with it so it is a little limited for their study. May be able to compare over time using these datasets, but they haven't gotten there yet.

Peter starts by saying he is very impressed with the Phase 1 studies. He points out that if we want to understand the context of CCC steelhead, Peter and other post docs wrote up a summary of their life history in a report for CalTrout which is available. That is one of the most thorough reviews of CCC steelhead to his knowledge. From a historical perspective, this is the most studied steelhead group, so there is a historic understanding of these fish and how flexible they are. He thinks it's tough to set real temperature standards of any sort since they are a fairly flexible fish species. Don't want rigid standards; want something flexible. We need to maintain ecosystem properties. Peter thinks the idea of where we put resources is interesting and ironic. In his opinion, LGC is one of the worst places in the whole CCC steelhead region to do habitat restoration for steelhead fish. He also thinks studying resident *O. mykiss* populations above the dams and *O. mykiss* below dams is important. Often times, resident populations above dams are ignored by the agencies, which makes it difficult to manage anadromous and residence populations together.

Scott notes Peter's earlier comment about looking just at steelhead or whether we look at other species too. When managing for one species are there risks or detriments to other species in the local area? When focus is on one thing, we may miss other species; not just fish, invertebrates, etc. Peter says this is always an issue that extends to invertebrates and other types of species, but he does note that *O. mykiss* are one of the more sensitive species and managing for steelhead does typically benefit many other species. However, they may not be the best indicator for overall ecosystem health due to their sensitive nature. Resident trout could be a better indicator of stream health, because not dealing with ocean, downtown migration, etc.

Tony asks, are the regulatory agencies comfortable with using steelhead as the canary in the coal mine? If yes, then we're on the right path but if not then we need to rethink our strategy.

Kevin in the Chat - Appreciate Peter's point. Water Board has a legal obligation to protect resident populations of rainbow trout under the cold freshwater beneficial use.

Peter mentions that the Smith and Li paper demonstrates the great success steelhead can have in degraded streams. He notes it is a study that demonstrates why setting temperature standards is so complicated because these trout are so flexible in their behavior. This paper is cited in the threshold review report with Jerry Smith. In the issue of Env Bio of Fishes.

Scott asks Matt to share the Smith and Li paper Peter mentioned and he will share it with the rest of the group.

Scott opens the discussion to the Regional Board members.

Katharine from RB1 notes it is correct that what has been done previously for temperature objectives and TMDLs is to look at the most sensitive species in a particular watershed. For most they are different salmonids. RB1 has steelhead, Chinook, and coho, so they use the temp requirements of all of them to set conditions. They also have examples where suckers are most sensitive. This is the way RB1 initially interprets objective of whether beneficial uses are being supported. They're also open to shifting approaches if a different species is most sensitive in a given water body. The focus on the CCC steelhead is because that is the most sensitive species that Valley Water manages.

Bryan McFaden notes the issue of single species management is a difficult one. That's why the temperature objective is about natural receiving temperatures. The natural thermal regime is what the water quality objective is getting at, and the way RB1 addresses it is to set requirements for the drivers of stream temperatures consistent with natural conditions. All temp TMDLs focus on stream shade, and define what that natural level of stream shade looks like. The implementation involves requirements that lead to riparian management that is consistent with mature trees and other things like the Shasta bulrushes, for example (natural vegetation). Similarly, with stream flows they need to be consistent with natural aspects in terms of timing and magnitude. What conditions are needed to support the natural receiving water goal? He also notes competing temperature requirements that happen on occasion, such as with steelhead and turtles. Bryan also notes the presence and absence surveys are not enough. Bryan thinks abundance may be enough if there is other data that puts it in context such as do they have access to cooler temperatures. It's important to understand if this is what steelhead are choosing or what they are stuck with. He notes the difference between habitat aspects sought for survivability versus preference/thriving. Bryan also notes that impairment designation doesn't mean there will be a bunch of money spent on an environment that doesn't make sense in terms of priorities.

Richard circles back to the comment on why LGC and investing money there. He notes RB2 has an obligation under the CWA to evaluate water quality data and whether it is supporting beneficial uses. RB2 has an obligation to evaluate whether those beneficial uses are supported in LGC. They have this obligation more broadly too. From the RB2's perspective, their goal is to have a "bright line" temperature that is key to these beneficial uses (e.g. cold water, migration,

spawning). They need to have an evaluation guideline for temp and other factors where it is reasonably foreseeable to have data to evaluate against these beneficial considerations. It is important to make the guidelines reflect available data to make this useful. Richard also cautions against using too much data from Australia/Idaho/other locations. He wants us to make sure this project isn't extrapolating data from steelhead cousins in other locations across the world because RB2 cannot use that to determine if beneficial uses are met in California.

Tony responds by saying the value of at least examining temperatures from other regions is to acknowledge the relative possibilities and how we only have a small amount of data available in comparison to other steelhead populations. Tony reiterates that the TRP will focus on what is relevant to the study area, but the question that is not clear is how far we can extend the populations to make the work a little easier. He doesn't think we should capture and work on fish on LGC, but there may be high levels of abundance in other streams that could be acceptable substitutes. The regulatory agencies may have a better grasp of this. Tony wants to make sure the TRP is on the same page with the regulators on terminology.

Scott mentions in closing that comparing LGC steelhead to southern streams outside of the DPS may be more similar to LGC steelhead than ones within the DPS to the north. It may be useful to revisit the DPS boundaries we are using.

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Closing slides and discussion

Scott presents his closing slides. He notes this is the 2nd meeting of the TRP, and the 3rd meeting if you count the field visit.

Next steps include setting the timing of the agenda for the next TRP meeting, probably in early Jan/Feb 2022. Scott will work with Valley Water and the TRP to determine the focus of the meeting and the list of participants. He also needs to sketch out the timing and agenda for the remaining two TRP meetings. Scott will be in touch in early 2022 with more info.

Lisa Bankosh (Valley Water) comments that she is very pleased with the discussion today.

Chat log:

From Tony Farrell, UBC, Canada to Everyone 09:32 AM

Thanks Lisa

From Kevin Lunde (SF Water Board) to Everyone 09:46 AM

When can non-TRP members read the Exponent Report referenced in this talk?

From Katharine Carter (she/her) - NCRWQCB to Everyone 09:51 AM

I think Tony's point and suggestion is right on. This is should be the first step.

From Tony Farrell, UBC, Canada to Everyone 09:53 AM

If so, we need to hear from the regulatory agencies for their valued opinions

From Kevin Lunde (SF Water Board) to Everyone 10:07 AM

Is Stillwater writing a new paper with current info or is the research mentioned today all in the 2020 paper?

From Richard Looker to Everyone 10:10 AM

Stillwater report repeatedly refers to 7-DADM of 18C, but SF Water Board used 20C for this metric. Why the mismatch?

From Kevin Lunde (SF Water Board) to Everyone 10:12 AM

Did you ask for data from NOAA or CDFW?

From Katharine Carter (she/her) - NCRWQCB to Everyone 10:21 AM

Great points Tony. Also presence and tolerance isn't indicative of preferred/optimal which does need to be considered to be fully protective of the beneficial use.

Regional Board is aware of many additional sources of additional temperature data in the Russian and would like the opportunity to share so these entities can be contacted.

From Katharine Carter (she/her) - NCRWQCB to Everyone 10:21 AM

Regional Board is aware of many additional sources of additional temperature data in the Russian and would like the opportunity to share so these entities can be contacted.

From Susan Paulsen (Exponent) to Everyone 10:29 AM

FYI - Sullivan et al. 2000 was included in Exponent's analysis of the PNW thresholds and is summarized in the Exponent report

From Tony Farrell, UBC, Canada to Everyone 10:32 AM

If Matt layered on fish condition factor with the abundance estimates, would this be more useful?

From Richard Looker to Everyone 10:37 AM

The suggestion for lagoon or estuary habitats is a good idea. There is currently a push by USEPA in comments to CA waterboards to use SF Bay temperature data evaluated against the PNW guidelines (migration) in the context of determining impairment. So - if this study does not take that on, that is a potential missed opportunity.

From Katharine Carter (she/her) - NCRWQCB to Everyone 10:43 AM

Does the TRP have questions for the agencies?
agencies?

From Katharine Carter (she/her) - NCRWQCB to Everyone 11:08 AM

I'd like to hear the TRPs thoughts on scope of studies and the amount of data needed to get meaningful/significant answers.

From Richard Looker to Everyone 11:08 AM

It may help - at some point - for the TRP and others to hear from regulatory agencies more about how we regulate. The water board regulates to protect so-called beneficial uses. For temperature, we have tried to find endpoints that represent protection of these beneficial uses. We have an obligation to protect all relevant beneficial uses, and that is why it is useful to have temperature endpoints tied to all relevant beneficial uses. We have some flexibility on temperatures required to protect these uses because we do not have numbers "set in stone" for this purpose.

From Kevin Lunde (SF Water Board) to Everyone 11:19 AM

To Mike: When developing evaluation guidelines or numeric water quality criteria The Water Board doesn't consider priorities in terms of where to take or ask for actions to improve water quality. So where to spend the dollar depends on many factors and occurs at totally separate and subsequent regulatory steps like issuing permits.

From Bryan McFadin - NCRWQCB to Everyone 11:27 AM

I think another consideration should be if there are cooler temperature environments that the fish have access to and pass up.

From Katharine Carter (she/her) - NCRWQCB to Everyone 11:27 AM

I think Tony's points are excellent and shows the complexity of the topic and need to explore studies outside the CCC.

From Jen Watson (Valley Water) to Everyone 11:28 AM

Yes, we have some reports we can share.

From Kevin Lunde (SF Water Board) to Everyone 11:35 AM

Appreciate Peter's point. Water Board has a legal obligation to protect resident populations of rainbow trout under the cold freshwater beneficial use.

From Tony Farrell, UBC, Canada to Everyone 11:38 AM

THX for this clarification Kevin

From Jessie Maxfield-CDFW to Everyone 11:52 AM

Switching over to my phone.

From Katharine Carter (she/her) - NCRWQCB to Everyone 11:58 AM

Thank you everyone for a great meeting.