Central California Coast Steelhead Regional Temperature Study Technical Review Panel (TRP) & Agency Representative Meeting 10am - 12:00pm, 03/30/22

Moderator/Presenter: Scott Dusterhoff, SFEI
Note taker: David Peterson, 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
- Michael Patton, WQCB
- Xavier Fernandez, WQCB
- Ryan Ham, WQCB
- Brian Thompson, EPA
- Luisa Valiela, EPA
- Eric Dubinsky, EPA
- Brian Kastl, EPA
- Ryan Dougherty, EPA
- George Neillands, CDFW
- Emily Jacinto, CDFW
- Jessie Maxfield, CDFW
- Ryan Watanabe, CDFW
- Sean Cochran, CDFW
- Joe Dillon, NMFS

Valley Water and consultants

- Jen Watson, Valley Water
- John Bourgeois, Valley Water
- Bassam Kassab, Valley Water

- Eric Olson, Valley Water
- James Downing, Valley Water
- Lisa Bankosh, Valley Water
- Lisa Porcella, Valley Water
- Matt Drenner, Stillwater Sciences
- Ethan Bell, Stillwater Sciences
- Andy Deines, Exponent
- Susan Paulsen, Exponent

Meeting Agenda

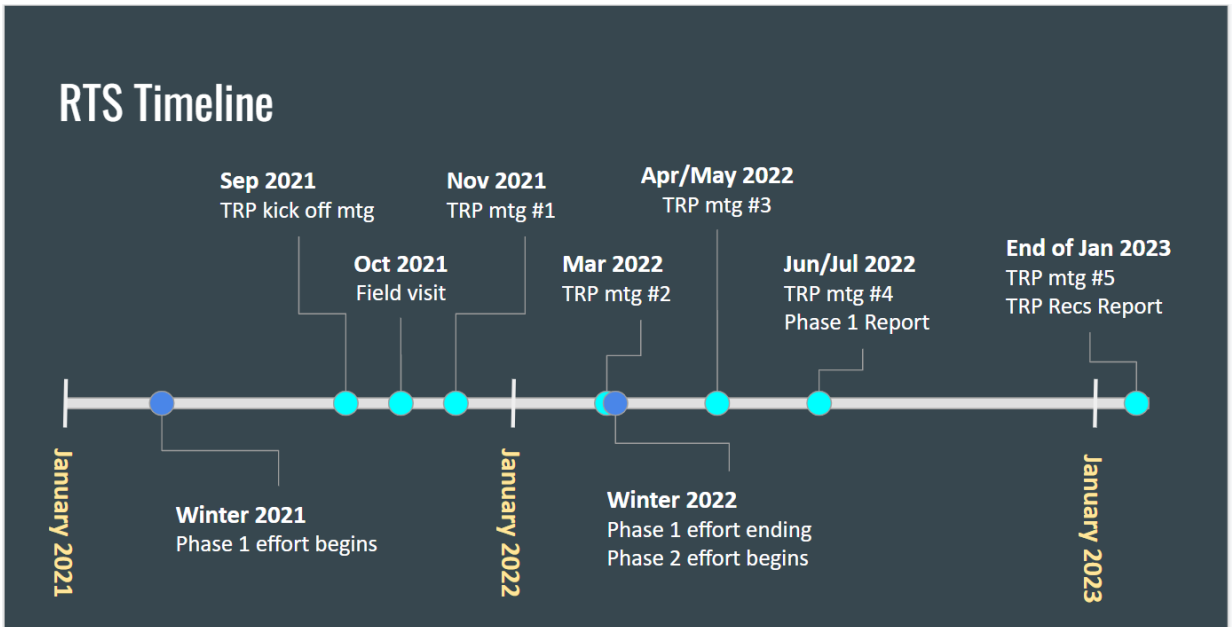
Welcome and RTS Overview	10:00 - 10:20 am
Presentation on Updated RTS Workplan	10:20 - 10:50 am
Presentation on Phase 1 Study Results	10:50-11:40 am
Next Steps	11:40 am - 12:00 pm

1. Welcome and RTS Overview

Scott Dusterhoff opens the meeting with an overview of the Regional Temperature Study (RTS). The goal is to develop an approach for refining regionally appropriate and scientifically rigorous temperature evaluation guidelines that support beneficial uses of CCC steelhead. The many participants in this study include Valley Water (the lead for this effort), San Francisco Bay RWQCB (SFBRWQCB), Technical Review Panel (TRP), Agency Representatives (RB1, CDFW, NFMS, EPA, SWRCB), Public Stakeholders, Stillwater Sciences and Exponent, and SFEI.

The project will be completed by January 2023, and work will culminate in a brief recommendations report from the TRP, which will include a summary of the important water temperature considerations for each CCC steelhead lifestage and recommendations for additional studies that support the development of temperature evaluation guidelines.

Phase 1 is coming to an end and Phase 2 is beginning now, in March 2022



2. Presentation on Updated RTS Workplan

Regional Temperature Study: Goals and Expectations
Jennifer Watson, Senior Biologist, Valley Water

Jen Watson gives an update on the RTS project workplan, which was updated as a result of further discussions with SFBRWQCB to clarify goals and determine what is reasonable to accomplish within the timeframe. Valley Water is coordinating with SFBRWQCB and interested stakeholders to complete a regional temperature study that identifies available data, data gaps, and develops scientific studies that can be used to refine temperature evaluation guidelines protective of CCC steelhead. At the time Los Gatos Creek was listed for temperature impairment, the RTS timeline was to be completed within two years. At their last meeting, Valley Water and SFBRWQCB discussed supplemental studies to fill data gaps and recommending numeric temperature criteria associated with sensitive life stages within this timeframe.

Valley Water will complete Phase 1 of this study, the analysis of existing data, but it will not be possible to refine CCC steelhead temperature criteria by January 2023. This conclusion was based on a more complete understanding of data gaps, partially stemming from discussions at the first TRP meeting.

The goals of RTS have shifted slightly. The goal of Phase 2 has been redefined: to develop an approach to refinement of regionally appropriate and scientifically rigorous temperature evaluation guidelines that support cold fresh water, migration, spawning, and related beneficial uses of CCC steelhead. The TRP report will identify the most sensitive life stages and important biological endpoints for CCC steelhead and recommend study methodology to assess protective temperature considerations associated with these endpoints.

Jen notes that TRP should begin by assessing the three guiding questions discussed during the last meeting.

1. What are the key factors to consider associated with determining suitable temperatures to support CCC steelhead COLD, MIGR, SPWN, and related beneficial uses in the study area (e.g., life stages that should be considered, food availability, growth rates, predation by and competition with warmwater fish species, disease, etc.)?
2. Do data exist that would allow for refinement of protective temperatures to support CCC steelhead COLD, MIGR, SPWN, and related beneficial uses in the study area?
3. If adequate data do not exist, what new data collection and/or experimental modeled data analysis should be prioritized for identifying suitable temperatures?

Jen points out that the study area and scale for the Phase 1 study was the CCC steelhead distinct population segment range. This was to increase the sample size and range of habitats included in the study beyond the limits of Valley Water's service area, Santa Clara County, and incorporate temperature variability, increasing the ability to detect responses while still being manageable given existing resources and timeframe.

Studies recommended in Phase 2 could occur at a different spatial scale than Phase 1 studies. Valley Water would like the TRP to provide recommendations on defining an appropriate scale. We expect Phase 1 will provide information on what an appropriate scale might be. Ultimately the scale of Phase 2 should be designed to be applicable, but not necessarily limited, to streams supporting CCC steelhead in Santa Clara County.

Phase 1 Stillwater Sciences has conducted a literature review and assessed the quantity and quality of available data within the CCC distinct segment population area. They are working on defining the probability of CCC steelhead occurrence based on temperature and an evaluation of whether temperatures are associated with fish condition. This information will be made available in a final report in mid-2022.

Phase 2 The TRP is tasked with reviewing data and documents and providing feedback on the technical studies being done within, and data being collected as part of, the RTS to identify important biological endpoints. The TRP will use the information provided in Phase 1 to identify and design a scientifically sound supplemental study or program of studies to refine regionally appropriate temperature guidelines. Those could include field or laboratory studies or additional data analysis. This will be summarized in the TRP recommendations report, written by SFEI based on TRP deliberations. All members of TRP will sign off on the final report, or note areas of dissent. Valley Water, regulatory agencies, and other participating stakeholders will preserve the independence of the TRP and provide objective consideration of their work product.

The TRP is welcome to use literature previously used by the SFBRWQCB as a starting point in identifying temperature considerations relative to CCC steelhead life stages. These include the EPA Region 10 Guidance (2003), Sullivan et al. (2000), and the State Water Resources Control Board 2018 Final Integrated Report (finalized in 2020). Jen highlights Table 1 from the EPA (2003), where they considered the spawning, egg incubation, juvenile rearing, and adult migration life stages. Sullivan et al. (2000) considered lethality, juvenile out migration, and juvenile rearing. The TRP will determine if these life stage metrics should be retained, adjusted, or if there are additional factors that should be considered.

Jen notes that they expect it will be very difficult to impossible to obtain permits to conduct studies where lethality is an endpoint when dealing with a listed species. So, is there a more suitable study or temperature consideration and what would that be?

In the previous meeting there was a discussion about whether steelhead are the most sensitive beneficial use or if other species should be considered. The TRP is welcome to provide recommendations for other species in their report, but the focus of the report should be on CCC steelhead temp considerations. Any supplementary study recommendations will be conducted after the RTS is completed. Such studies would be conducted in partnership with regional stakeholders, including other interested water agencies and SFBRWQCB and will require assistance with multiple factors including study scope, schedule, permits, and regulatory constraints, laboratory and organism availability, and funding. The timeline for implementing supplementary studies will be based on these factors.

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Q&A session

Tony Farrell likes the refocusing of the workplan that Jen presented. He is looking for "low-hanging fruit"--what can be changed quickly and what will take time. Those details weren't clear in Jen's presentation, so can we make sure to incorporate what could be done into that document? For example, in San Jose, shade is important in-stream in habitat reconstruction. Can shade be incorporated downtown too? Shade might be low-hanging fruit.

> Jen – Those types of things are the next step, but for now we want to focus on temperatures appropriate for steelhead. That will help SFBRWQCB when they list streams for impairment, and after that we can address how to fix the issues.
>
> Nann Fangue comments that she also likes the update

Brian Thompson comments on the first page of the workplan. Wants to make sure that, while the quotation is accurate, it's clear that the EPA's position is that they do not believe the Region 10 thresholds are not applicable to areas outside of Region 10. He doesn't want that quote from EPA 2003 to imply otherwise. He is suggesting that that part of the document could be reworked to ensure the EPA's position is clear. Jen will note EPA's current position.

> Tony - question to Brian. Is the question that the TRP needs to address: Why should we not accept the current EPA document? Tony wants to know how to address the framework that exists and what would be the language to do that?
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> Brian - we don't need to say what wouldn't work from EPA 2003. The focus is to look at the best data we have and go from there.
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> Tony - Big data gap in EPA 2003 is temperature acclimation. Field has moved since then to include a wealth of data related to that.

Luisa Valiela - The list of 3 references that Jen listed as available- is that the list after an exhaustive search of relevant reference material, or do we expect other guidance material to be added as the work progresses?

> Jen - those references are what was used in EPA 2003, but Stillwater has already done a literature search relating temperature and CCC steelhead, and TRP can refer to that also.

Kevin Lunde - Great improvement upon last version. Refresher: SFBRWQCB looked at a number of other references including Sullivan et al. (2000), have 3 references to support lethal effects at 24 C. Want to support different analyses and references for chronic

growth effects, disease effects, and where bright lines are when determining lethal effects. SFBRWQCB wants to make use of all of those when making decisions about cold water beneficial use.

3. Presentation on Phase 1 Study Results

Central Coast California Steelhead Temperature Tolerance Studies Update
Matt Drenner, Senior Fish Biologist, Stillwater Sciences

Stillwater Sciences has been able to gather a bunch of data and synthesize results. Matt begins with background points: temperature is a critical abiotic factor for fish, there are inter- and intra-specific tolerances, and we need more population/region-specific information for management of these species. The objective of Phase 1 is to characterize temperature tolerance of CCC steelhead using existing data. Can we identify upper temperature limits? Explore intra-specific variability within CCC steelhead.

Stillwater reached out to entities and individuals within the CCC steelhead DPS area and asked for data. Data sources included steelhead or resident rainbow trout (*O. mykiss*) surveys, continuous temperature monitoring data in the region, and anything related to habitat or growth. Matt focuses on the *O. mykiss* surveys and continuous temperature monitoring in this presentation. Matt notes that many temperature monitoring sites are in different locations than the fish survey sites. Ultimately, Stillwater processed the data to spatially and temporally match temperature and fish survey data.

Data Analysis: find the probability of CCC steelhead occurrence based on temperature. They used Generalized Additive Models and included distinct tributaries and years as variables to best fit the models. The goal is to determine temperature tolerance ranges and upper limits. The temp metric mean weekly average temperature (MWAT) is commonly used, but can be defined differently in literature. Stillwater defined the metric they used as the weekly average of daily mean over max (over the previous 7 days of a fish survey). Daily max gets at acute critical temperatures. Daily mean might relate to growth or condition factors. These tended to be better than annual and daily statistics.

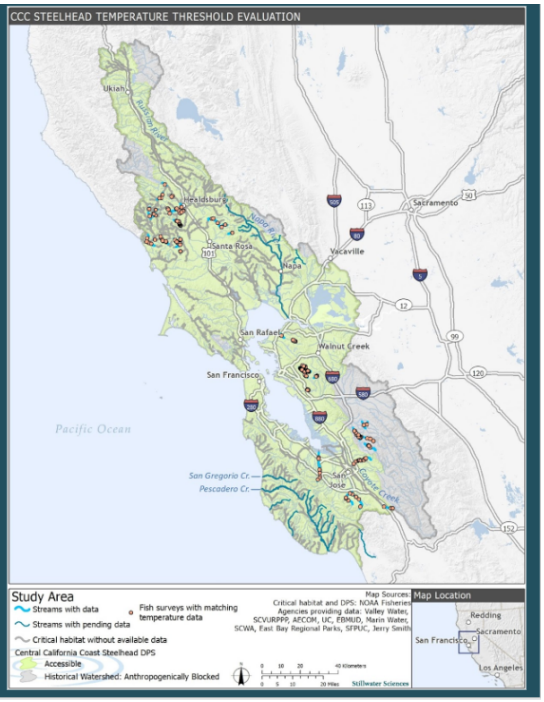
Preliminary Results: Data points on the map shown are locations where we have fish survey data that matches with continuous temperature data. Individual locations may be repeatedly sampled over time. Streams highlighted in darker blue (e.g., Napa River watershed) are still being processed. Overall, we have a pretty good spatial distribution of data, which captures a lot of variability. We have over 1,000 sites over 18 years (1999-2021). The Russian River has an exceptionally large sample size (n = 848).

Preliminary Results

Watershed/Area	Agency	Matching fish/temp sites
Russian River	SCWA	848
San Pablo Bay	EBMUD	26
Coyote Creek	Valley Water/SCVURPPP	9
Coyote Creek	Jerry Smith	13
San Francisco Bay	SFPUC	130
San Francisco Bay	EBMUD	46

• n > 1,000

• 18 years (range = 1999 – 2021)



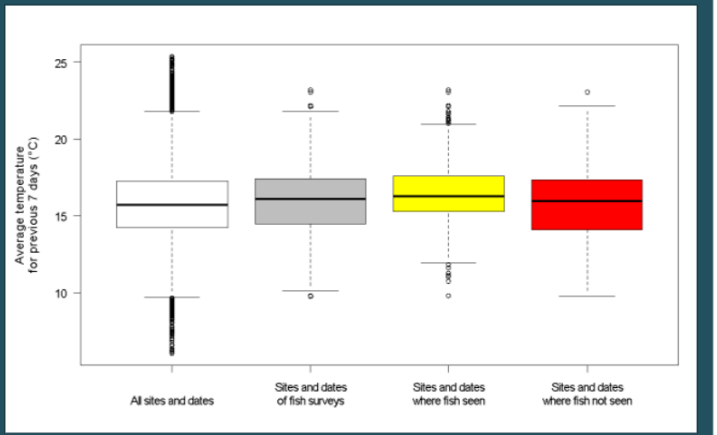
6

Today's presentation focuses on the Russian River because it is the most robust dataset and was used to train models. Across the entire study area, weekly average temps (for the 7 days prior to an *O. mykiss* survey) range from 10-26℃ and weekly average daily max range from 10-30℃. Locations with both temp and fish survey data have less data on both high and low temp extremes compared to all of the data received. There isn't much difference in temp at sites where fish were observed vs sites where fish were not observed.

Temperature*

• Weekly average = 10 – 26°C

• Weekly average daily max = 10- 30°C



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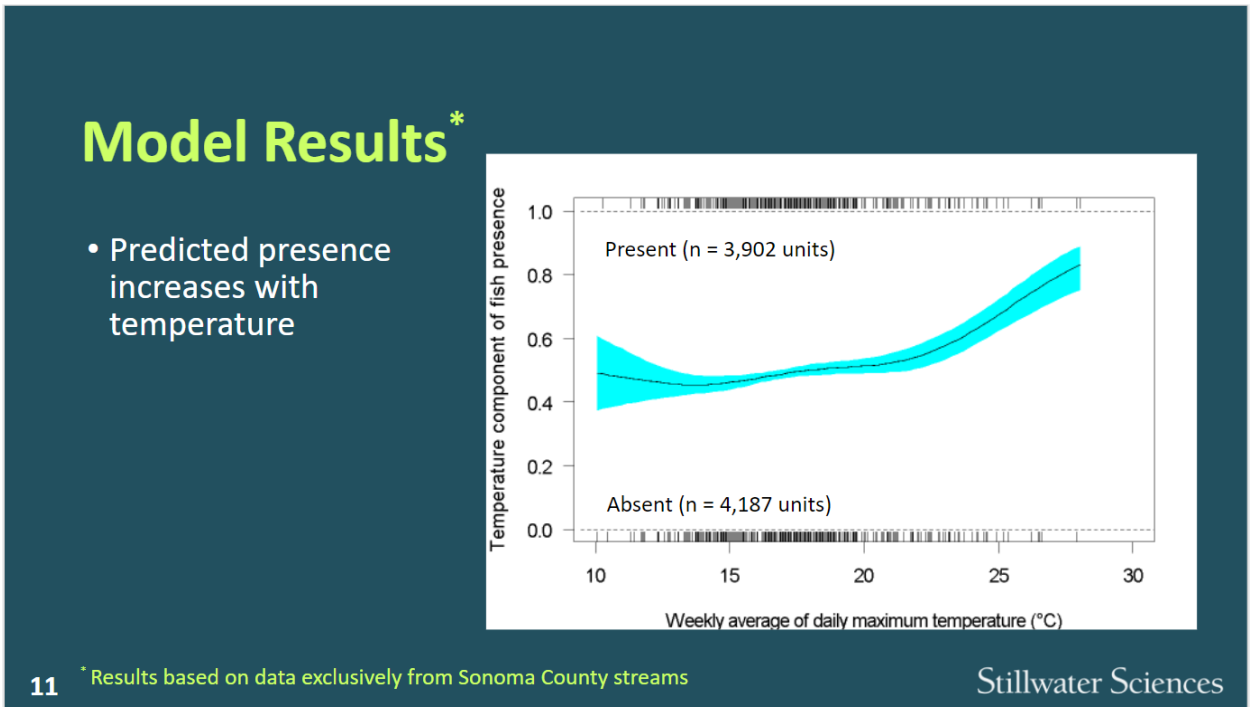
* Results based on data exclusively from Sonoma County streams

Stillwater Sciences

Model Results: X-axis shows weekly average of daily max temp. Y-axis shows probability of fish occurrence, with zero at bottom and one on top. Sample sizes of presence and absence are fairly equal using survey units. They looked at defining sampling unit by reach, but it's difficult to define a reach. Some survey reaches can be 4 km long. Further, by defining samples by entire survey lengths, they would lose nearly all instances of fish absence.

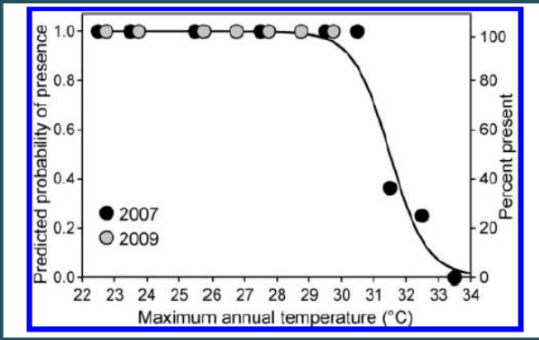
The model shows an increase in fish occurrence probability as temperatures increase. This is not what we expected or necessarily believe. Matt explains this is some artifact of the data we have. So why are we seeing this (likely unrealistic) increase in fish occurrence probability with temperature?



Limitations: Survey Design. Surveys have a variety of objectives, and sometimes are targeting where we know fish are at a given time. There are also limited sites with higher temperatures in our dataset. We don't have data from sites >30℃ and while we see fish appear to tolerate temps for data we do have, the surveys aren't capturing an upper threshold for lethality. Matt references a plot from Sloat & Osterback (2013) that shows probability of *O. mykiss* occurrence declines steeply over 30℃ in southern California, but we don't have data over that threshold and we aren't seeing an upper lethality limit yet. Survey timing also is limiting. Many groups aren't allowed to sample above a threshold (e.g., 18℃), so agencies typically collect data during the fall when temps are cooler. There is seasonality in sampling, and there may be limits to fish mobility during sample times. For example, surveys might only occur in pools where fish are isolated and agencies can snorkel survey.

Limitations

- *O. mykiss* survey design
- Limited sites with high temperatures
- Temperatures not lethal
- Survey timing limitations (permitting)
- Seasonality (sampling and fish behavior)



From: Sloat & Osterback 2013

13 Stillwater Sciences

Summary/Conclusions: The data we have shows evidence of temperature tolerance. We can't define an upper temperature limit due to our limited sites with high temperature records. Evaluating tolerance does not mean we're evaluating optimal temperatures for steelhead. Important for informing Phase 2, we are starting to characterize regional temperatures and some thermal eco-physiology of steelhead in this region.

Next Steps for Phase 1: data processing from some locations is ongoing. Hope to see some higher temps in those data. They want to explore other covariates of habitat conditions – if temperature isn't limiting fish presence/absence, what is? They are also exploring using condition factor as a surrogate for growth rates, looking at condition factor of fish that are captured using similar temperature metrics as previously discussed. Expect their report to be completed in summer 2022.

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Q&A session -

Mike Deas - Are your data suggesting that fish are being forced into warmer habitats because of downstream thermal barriers or upstream migration blockage, for example? They might just be in a warmer habitat because that's the only place to live.

Matt - Can't say for sure. Fish might not be able to find more suitable habitat, but that could be due to characteristics of these systems. Regardless of being forced into these habitats, they're surviving, but that doesn't get at how well they're tolerating. At the times of year these surveys happen, migration ability is very low.

It would be interesting to see temperatures along streams at a finer scale to look at availability of thermal refuge.

Mike – Do you think the model developed in the data-rich Russian River will be applicable to other watersheds? Are you comfortable with the number of observations you have in other basins?

Matt – Yes, the study is designed to do that. It is a good point not to overshadow important data with just a lot of data. He will take that into account.

Mike – The power of the model will be to identify if it's doing a good job or if/where we need more data

Matt – If we're able to use data from one watershed and apply it successfully to other watersheds, we will do that.

Tony – Great presentation. Now we're at the point of setting principles for what we can and can't do with the data. The first is the transfer of model from Russian River to Los Gatos. The question is less about data points, but rather does that steelhead population have the same genetics between watersheds? We need to have a genetic ID and have comparability. That ID will be key in the transferability of datasets between watersheds.

Tony – There are limitations to how you can interpret the data. Presence and absence can only tell you so much. Need to be clear about what you can and can't do. Matt hit on big issues with data quality: When were data collected? Probably not in winter. Density of temperature use will be a useful metric. Tony encourages Matt to look more at what temperatures might have been available at the time of an observation in order to get at preferred temperature or is the fish there as a result of a blockage. This is a big ask, but we have to be careful about how we use those data. Minimum use of data is: was a fish there at that temperature? Why was it there? Is there a condition factor? Final point: If you generate a density plot for temperature and overlay different thermal performance curves on top. Normalizing by amount of data points would be great.

Matt – Matt has started to explore densities and they're finding higher densities at higher temperatures. A next step will be to see what resolution we have from temperature loggers. We saw where surveys occurred the temperature range was constrained, but that could be due to sample design.

Tony - Another note: you need to define tolerance because you don't know how long the fish has been there. That definition can be adjusted later.

Peter – Do you anticipate doing these models taking climate change into account, with warming streams and increased drying?

Matt - that is not on the agenda at this point, but it is an interesting thing to consider.

Peter – Are permitting issues impacting surveys?

Matt - Can't fully answer, but my understanding is that surveys are limited by temperature (can't survey above 18 degrees).

Peter - Are surveys electrofishing or snorkel?

Matt - Sonoma County are all snorkel, but other watersheds have a mix of snorkel and electrofishing.

Nann Fangue - What are the advantages and disadvantages of looking at all the data together? Are there subsets of data that could address limitations that Tony brought up? For example, if we don't know if a fish is actively choosing or being forced into these temperatures, are there data that could be used as a gauge/correction/covariate that incorporates availability of a temperature gradient?

Matt - This makes sense, but unsure whether we have that type of data. We don't have empirical data at that spatial resolution, but we're looking into finding more temperature-focused surveys. But there are models for predicting temperature across longitudinal gradients. Matt is not too familiar with the accuracy of those models.

Nann - Are locations where fish are observed sampled frequently (over the course of a day or several days in a row) to determine how transient fish are?

Matt - Surveys occur on a single day. The survey season extends for weeks or months, but a single location typically only gets surveyed once. Maybe incorporating PIT tags would be extremely valuable, but Matt hasn't encountered data like that yet.

Scott - When might your results be available for the TRP?

Matt - What we plan to do can be done fairly quickly, a couple of months. It depends on what extra analyses we want to explore.

George Neillands - A comment about datasets from Sonoma County. The data come from surveys focused on coho salmon as part of endangered species monitoring. A lot of it is associated with the Coastal Monitoring Plan. Surveys capture cooler temps lower in watershed where coho are. The upper watershed is not sampled as much, and that's much hotter, much drier, and predominantly steelhead present, so keep that in mind then using these data.

Matt - Some reports were provided in the upper watershed, but didn't include temps. There might be gaps to fill there.

Kristina Yoshida - Noticed no data from coastal Marin area, are you able to get data from that area? San Gregorio and Pescadero in San Mateo Co are very important for steelhead populations. Also, SWAMP has collected quite a bit of continuous temperature data, and maybe that can match up with some fish data that you get from agencies.

Matt - We do have data provided for San Gregorio and Pescadero that are still being processed. The reports are limited in describing spatial distribution of fish. We haven't been able to get much information out of Marin County reports. I'll make a note to look back into that. I'll reach out to you about SWAMP data, but we're often limited by fish data. There is a lot of temperature data for those creeks, but less fish data.

Kevin Lunde - More temperature data exist, so let's try to connect those with where fish data exist. That can be a valuable feedback loop to those programs to encourage more temperature data gathering where fish studies are happening.

Matt - In conversations with data sources, everyone is interested in incorporating temperature into their studies. May be important to produce map of existing data sources to show to different groups.

Kevin - SWAMP collects riparian shade with a densiometer, so those data might be worth exploring in relation to fish surveys. SFEI might have some standardized tools for riparian cover and shade.

Scott - CRAM sites around the region may also include shade data.

Joe Dillon - Did Sonoma County give information on species other than salmonids?

Matt - No they did not.

Joe - Was it mostly mainstem?

Matt - Very little mainstem. Mostly tributaries associated with the Coastal Monitoring Program.

Joe - On the mainstem there are predation issues that could influence distribution of juvenile salmonids. Other large tributaries may have the same issue. Many tributaries dry up at the confluences, and in drought years go mostly dry. Some surveys may have been doing snorkels for fish rescues.

Brian Kastl - Has also been working on temperature in the Russian River for his PhD. Thinks there may be other variables to include, like flow. Lower temperatures are found in lower flow due to greater proportion of groundwater inputs. That relationship could be throwing off the results because higher flow could mean higher dissolved oxygen. By including some explanatory variables, you could maybe disentangle the true effect of temperature in the models.

> Matt - Those are great points. What we thought about with groundwater – logger placement is typically at the bottom of pools. A challenge was determining when loggers might be out of water. It's hard to spot check groundwater influence. Loggers are often not in the same pool as survey data, so we're looking at that variability upstream and downstream as well.
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> Peter - Follow up to Brian's comment. Salmonids know where seeps are, and they hang out there during hot part of day. Definitely worth looking at.

Kevin - Regarding the Sloat and Osterback (2013) study referenced: was this shown as a study design approach or to imply that the numerical results are applicable here?

> Matt - I wasn't applying a specific numerical result, but the approach of identifying temperature thresholds and what we would expect to see if we hit an upper lethality limit in our dataset. We might be missing the data points they have to recreate their trend lines.
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> Kevin - I'd be interested in how many watersheds we see that curve in. Rather than lump the data together, do we see similar trends in different watersheds?
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> Matt - We're going to apply the model individually by watershed if data is robust enough. If we don't have enough data, then try to lump streams based on thermal conditions.

Kevin - To touch on Nann's comment, it would be very helpful to resurvey studies over the course of a summer. There might be a couple datasets out there that look at survivorship. But what is the control? What is the natural survivorship rate?

> Matt - Phase 2 might recommend field-based studies including PIT tagging to get at movement and growth. Those could be fruitful studies to inform future temperature guidelines.
>
> Kevin will pass on a paper or two he knows as a resource for Matt.

Matt and Scott - We could provide a list to the group of what data they have, and people can think about what data might be missing.

4. Next Steps

Timeline

- TRP meeting in Apr/May 2022
- TRP meeting in Jun/Jul 2022
    - Will involve the public
- Final TRP meeting Jan 2023