



Pacific Fishery Management Council

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September 12, 2022

Dr. Scott Rumsey, Acting Regional Administrator
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West Coast Region
1201 NE Lloyd Blvd. Suite 1100
Portland, OR 97232

Mr. Ernest Conant, Regional Director
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Federal Office Building
2800 Cottage Way
Sacramento, CA 95825-1898

California State Water Resources Control Board
Ms. Eileen Sobeck – Executive Director
Cal EPA Building
1001 "I" Street
Sacramento, CA 95814

Re: Sacramento River Temperature Targets

Dear Dr. Rumsey, Mr. Conant, and Ms. Sobeck:

The Pacific Fishery Management Council (Pacific Council or Council) is writing to express its grave concerns regarding the adequacy of current Federal California Central Valley Project (CVP) maximum daily average water temperature targets for the Sacramento River below Keswick Dam, temperature limits which it is necessary not to exceed in order to prevent the loss of endangered winter-run Chinook salmon eggs in the Sacramento River below these dams.

After decades of habitat loss, winter-run Chinook salmon today spawn almost entirely within only a very short stretch of the Sacramento River just below Keswick Dam, making their eggs particularly vulnerable to elevated water temperatures within that reach. Water temperatures in that river segment are controlled primarily by the U.S. Bureau of Reclamation (Reclamation), primarily by use of the cold-water pool resources of Shasta Reservoir at Shasta Dam, which is part of the Federal CVP.

Our primary recommendation to water managers is to update outdated targets for temperature management related to winter-run Chinook salmon egg-to-fry survival so that they reflect current management practices and the best available science on relationships between the cold-water pool

Upper Sacramento water temperatures, and egg-fry survival of winter-run Chinook. Below we lay out some of these science and policy details. At the end of this letter, we provide specific recommendations to water management authorities.

While the recommendations of this letter will specifically address high water “temperature-dependent mortality (TDM)” impacts to the eggs of endangered winter-run Chinook salmon, our concerns also include all distinct populations of Chinook salmon within the California Central Valley, all of which lay eggs that are affected by various similar high water temperatures within that river system. We believe these protective temperature limits are not only inadequate to protect egg incubation for these Chinook salmon species, but are also no longer based on the best available science, as explained below.

Populations of winter-run and spring-run Chinook salmon are currently so depressed within California’s Central Valley river systems that these species are both Endangered Species Act (ESA)-listed, and thus federally protected. And while not themselves ESA-listed, the far more abundant Central Valley fall-run Chinook salmon are nevertheless an important prey species for the endangered Southern Resident killer whale, but now also seriously depressed in numbers within the California Central Valley. Since all Chinook salmon runs intermingle at sea, decreases in the survival rates or abundances of winter-run Chinook salmon can directly impact Council-managed ocean salmon fisheries by greatly limiting fall-run Chinook salmon harvest opportunities afforded to Tribal, commercial, and recreational fishermen all up and down the coast.

Water temperature targets necessary to protect winter-run Chinook eggs within that species’ last remaining spawning areas within the CVP operations area are currently managed pursuant to the Reclamation’s still in place 2019 Biological Opinion, as modified by a 2022 Interim Operations Plan (2022 IOP) and the Sacramento River Temperature Management Plan for Water Year 2022. These water temperatures will be managed in the 2023 water year under a similar proposed 2023 Interim Operations Plan (2023 IOP). These IOPs define a process, operational priorities, and thresholds for certain actions, including establishing water temperature targets at certain key measuring points.

Similar water temperature targets are being discussed as part of the ongoing reconsultation for the CVP’s operations under the Federal ESA and essential fish habitat (EFH) provisions of the Magnuson-Stevens Fishery Conservation and Management Act (MSA), in response to recent litigation.¹ These ongoing negotiations thus make this letter very timely.

¹ In particular *Pacific Coast Federation of Fishermen’s Associations (PCFFA), et al. vs. Raimondo*, US Dist. Court of CA, Eastern District, Case No. 1:20-cv-00431, and *California Natural Resources Agency (CNRA) vs. Raimondo*, US Dist. Court of CA, Eastern District, Case No. 1:20-cv-00426, as related cases. During this litigation the Court remanded (*but did not vacate*) the 2019 Biological Opinions from the prior Administration, and the current Administration reinitiated ESA reconsultation. In the meantime, CVP operations are being governed by Reclamation and the State of California under the water temperature standards of the previously challenged (but still in place) 2019 BiOp as modified by a Court-approved Interim Operations Plan (IOP) for 2022. Reclamation and the California Department of Water Resources are currently in negotiations with the intent to submit a 2023 IOP to the Court for approval soon, and a 2024 IOP may become necessary, depending on how fast the ESA reconsultation process can be completed. This litigation is currently under a temporary rolling “stay” to allow ESA reconsultation to proceed under Court supervision.

The Impact of the CVP's Water Temperature Management on West Coast Ocean Salmon Fisheries and Essential Fish Habitat (EFH)

The Council was established under the 1976 MSA (16 U.S.C. §1801 *et seq.*) and has management authority for more than 119 fish species in Federal waters off Washington, Oregon, and California, including Chinook salmon stocks occurring within the Sacramento/San Joaquin river systems. The MSA also charges the U.S. Secretary of Commerce to include provisions to identify, conserve, and enhance EFH for Council-managed species.

The Pacific Council is required to designate EFH for Council-managed species under §305 of the MSA, and to comment on Federal agency actions that may adversely affect that EFH. All tributaries and mainstems of the Sacramento and San Joaquin river systems, and most of the habitat historically accessible to Chinook salmon, as well as estuarine waters (including the San Francisco Bay Delta) are currently designated as Chinook salmon EFH. Accordingly, the Council has determined that certain areas and conditions contained within the CVP operations area constitute EFH.

The EFH description contained in the Council's Pacific Coast Salmon Fishery Management Plan lists known threats to salmon habitat such as dam construction, reducing in-river flow, levee construction, excessive logging of riparian habitat, and pollution from both agricultural and urban runoff. These threats lead to loss of water quality, including elevated water temperatures, increased turbidity and suspended solids, flooding and dewatering of spawning areas, and alteration of the natural flow regimes, among other impacts. The EFH description also identifies beneficial habitat factors listed as EFH including side channel habitat, channel margin shading, high riffle/pool ratio and structure, and presence of large woody debris.

The Council is greatly concerned that CVP operations under current high water temperature regimes would result in substantial adverse effects to Council-designated EFH for Central Valley winter-run Chinook salmon and other managed salmon species. For instance, the 2022 IOP's water temperature targets (i.e., allowing daily average temperatures below Keswick Dam of up to or above a non-mandatory "target" of 55° F at the Clear Creek (CCR) Gauge control point) will substantially adversely affect Council-managed fisheries and EFH that the Council has identified as necessary for the propagation of those salmon fishery resources.²

As further explained below, the Council is also concerned that neither the current salmonid 2019 Biological Opinion (BiOp), nor the 2022 IOP modifying that BiOp and currently being implemented, provide adequate measures to mitigate CVP high water TDM impacts on winter-run Chinook salmon eggs. We are also very concerned that similarly inadequate water temperature targets may be carried over into a proposed 2023 IOP, and a later Biological Opinion.

The CVP's Operations Have Failed to Protect the Redds of Winter-Run Chinook from Fatal Water Temperatures Below Keswick Dam

² <https://www.pcouncil.org/documents/2019/08/salmon-efh-appendix-a.pdf>

Many of our concerns regarding all of these California Central Valley Chinook salmon stocks, including high water temperature problems within the CVP's water supply system, and potential remedies, have previously been expressed in our prior letters to Reclamation³, to National Marine Fisheries Service (NMFS), and to the California State Water Resource Control Board (SWRCB).⁴
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Any actions that increase water diversions from, or increase water temperatures within, the Sacramento/San Joaquin River systems are very likely to exacerbate an already dire situation for these depressed salmon stocks and the fishing communities that depend upon them for their livelihoods. Avoiding additional constraints on Council-managed fisheries by avoiding, minimizing, or otherwise offsetting adverse effects to California Central Valley EFH is thus of paramount importance to us.

In Council letters in 2015 and 2016 (see letters cited in footnotes 5 and 6) we raised serious concerns then with Reclamation regarding its loss of temperature control at Lake Shasta and the Sacramento River downstream of CVP facilities there, control losses which resulted in extreme levels of winter-run Chinook salmon TDM in those years. In response, in 2017 NMFS developed a draft amendment to the Reasonable and Prudent Alternatives (RPA) for Shasta Dam operations contained in the 2009 CVP Biological Opinion to prevent the reoccurrence of these unacceptable conditions.

The Council is especially concerned about the impacts of proposed future CVP operations on endangered winter-run Chinook salmon egg TDM levels downstream from Lake Shasta. In particular, the Council is concerned that NMFS' 2017 proposed mitigation amendments, as well as many of our earlier Council recommendations, *were never incorporated into the 2019 BiOp*.

As a result, under the daily average water temperature targets of the 2019 BiOp, winter-run Chinook salmon experienced very low freshwater survival rates in 2020, and catastrophically low survival rates in 2021. Survival from the egg life stage to the fry life stage (egg-to-fry survival) was estimated to be only 11.46 percent in 2020, the third lowest level in the previous sixteen years, and approximately one-half of the average survival rate over that same sixteen-year period.⁶ Conditions were even worse in 2021, when winter-run Chinook salmon again experienced extraordinarily poor spawning and incubation conditions, with a major factor being the high river temperatures that were under Reclamation's control and that resulted in an egg-to-fry survival rate of *only 2.6 percent*.⁷

³ <https://www.pcouncil.org/documents/2019/12/december-2019-letter-to-nmfs-and-bor-on-central-valley-project.pdf>

⁴ <https://www.pcouncil.org/documents/2016/04/2016-letter-to-bor-on-sacramento-water.pdf>

⁵ <https://www.pcouncil.org/documents/2015/05/2015-letter-to-bor-on-central-valley-temperatures-and-flows.pdf>

⁶ Letter to Kristin White, Central Valley Operations Manager, Bureau of Reclamation from Cathy Marcinkevage, Assistant Regional Administrator, NMFS, Jan. 25, 2021, at p. 4-5, Figures 1 & 3, available at: <https://media.fisheries.noaa.gov/2021-02/nmfs-by-2020-jpe-letter.pdf>

⁷ <https://media.fisheries.noaa.gov/2022-01/jpe-letter-2021.pdf>. Emerging thiamine deficiency was an additional mortality factor in 2021, but not one under human control. Naturally occurring thiamine deficiency problems simply underscore the importance of taking a much more precautionary approach toward making use of those factors, such as water flows and temperatures, that we do have under our control.

NMFS has found that the record low egg-to-fry survival rates for winter-run Chinook below Keswick Dam in 2021 were caused primarily by lethal water temperatures. NMFS's hindcast (not forecast) mean estimate of TDM for the winter-run Chinook in 2021 is 75 percent.⁸ In the past several decades, only 2014 (at 77 percent) and 2015 (at 85.4 percent) had higher levels of winter-run Chinook salmon egg TDM.

The CVP's operations as described under the 2019 BiOp, even as modified by the 2022 Interim Operations Plan (IOP), have also eliminated important carryover storage requirements in Lake Shasta and fail to require water temperatures sufficient to minimize TDM consistent with the best available science. Even current water temperature limits, inadequate as they are, are only "targets," not requirements, under the 2019 BiOp and 2022 IOP. This lack of enforceable water temperature standards since 2019, plus lack of any inter-annual storage carryover requirements, contributed greatly to past water management failures to maintain adequate cold-water storage at Shasta Dam for salmon, and since 2020 has resulted in devastating levels of winter-run Chinook salmon egg TDM.⁹

Although 2022 TDM numbers are not yet finalized as of the date of this letter, the winter-run Chinook salmon egg TDM rates for 2022 below Shasta Dam have been projected by the SWRCB to be in the 39-46 percent range this year¹⁰ – *high TDM rates for the third year in a row for an endangered species that has on average only a three-year lifecycle.*¹¹

The Council also remains extremely concerned that the CVP system will continue to be operated in ways that fail to ensure adequate end-of-September storage necessary to provide cool instream water temperatures for salmon in the following water-year, resulting in a repeating cycle of additional years of high salmon egg mortality.

Previously Assumed Temperature-Dependent Egg Mortality Thresholds Are Too High

Previously, in egg mortality analysis work done only in laboratories, under highly controlled (but non-natural) conditions, it was found – in studies now more than 12 years out of date – that the seven-day average of daily maximum water temperature for Chinook salmon egg TDM mortality could be about 56.0° F. This is also the water temperature threshold included as a water quality standard in the Central Valley Basin Plan and included as a term and condition in Reclamation's water rights by the California State Water Resources Control Board (SWRCB) in its water rights Order 90-5, which was adopted in 1990. Order 90-5 requires Reclamation's CVP operations to meet 56° F in the Sacramento River at Red Bluff Diversion Dam,¹² or a location upstream after

⁸ SWFSC 2021, Oct. 24, 2021, Water Year 2021 Winter-Run Chinook Temperature-Dependent Mortality Estimate.

⁹ The serious water Shasta Reservoir storage shortfalls we see today were exacerbated by drought, to be sure, but over-appropriation of shrinking water supplies in 2020 and 2021 in the midst of that drought, betting on rainfall that never came, could also have been avoided by taking a more precautionary water-storage management approach.

¹⁰ <https://www.usbr.gov/mp/bdo/docs/srttg-meeting-summary-06-23-22.pdf>

¹¹ These low levels of egg-to-fry survival over the three-year period of 2020, 2021 and 2022 are almost certain to exceed the incidental take limit of winter-run and spring-run Chinook salmon authorized in the 2019 BiOp. See 2019 BiOp, at 801.

¹² Or alternatively, to a location upstream of this control point, after consultation with the California Dept. of Fish and Wildlife, the U.S. Fish and Wildlife Service, the National Marine Fisheries Service and the U.S. Western Area Power Administration.

consultation with the California Department of Fish and Game, the U. S. Fish and Wildlife Service, NMFS, and the U. S. Western Area Power Administration to protect the “salmon fishery.” However, in recent decades Reclamation has not been able to provide suitable water temperatures to Red Bluff Diversion Dam, and instead the SWRCB has to approve annual temperature management plans moving the temperature compliance point far upstream of Red Bluff Diversion Dam, shrinking available spawning habitat and further harming salmon.

Today, Reclamation is supposed to meet its CVP operations average daily water temperature standards at specific control points below Keswick Dam for ESA-listed winter-run Chinook salmon, which can now spawn only in those carefully temperature-controlled stream reaches. The water temperature standard of 56.0° F for winter-run Chinook salmon in the 2019 Biological Opinion is still in effect, although modified to 55.0° F by Court Order and the 2022 Interim Operations Plan (IOP) at the Clear Creek Gauge from May 15 to October 31 for Critical Year types (2022 is classed as such).

However, since the SWRCB Order 90-5 standards were established in 1990, scientists with NMFS have concluded that 56° F is not protective enough of winter-run Chinook eggs in the field, and peer-reviewed scientific studies have instead concluded that 53.5° F is the point at which temperature-dependent mortalities begin, as temperatures increase. These new models have been developed by the NMFS Southwest Fisheries Science Center and published as “Phenomenological vs. biophysical models of thermal stress in aquatic eggs” (Martin, *et al.*, *Ecology Letters* (2016)), with follow-up studies published as “The biophysical basis for thermal tolerance in fish eggs” (Martin, *et al.*, *The Royal Society, Proceedings B* (2020)). Those key studies are cited in more detail below. The key point is that the Martin, *et al.* (2016) modeling method used conditions that typically occur in-river (i.e., in the wild), including additional factors such as oxygen saturation (which also varies by temperature) and stream velocity to ascertain how salmon eggs, laid together in their “redds” would actually respond to stream temperature increases in the wild. These models form the basis for temperature management under the Sacramento River Temperature Management Plan for Water Year 2022.

As noted above, SWRCB recently forecasted that persistent daily average river temperatures of 55° F or higher (the standard allowed by the 2022 IOP) at typical measuring control points (e.g., at CCR) below Keswick Dam will lead to 39 to 46 percent TDM for winter-run Chinook salmon eggs this year. *A critical issue that is often overlooked is that this number is likely also an underestimate of total TDM because river temperatures are not constant over the course of a day – a 55° F. daily average temperature means the eggs will likely be exposed to even higher temperature “spikes” during the day.*

These already very high TDM estimates for 2022 are also likely to be exceeded – in spite of the 2022 IOP 55° F. target, actual instant water temperatures at the CCR control point have already exceeded 59.0° F this fall for several days running, and potentially could exceed 60.0° F for several more.¹³

¹³ Temperature monitoring and additional TDM modeling is, of course, ongoing as the summer proceeds, and these TDM estimates are subject to change on the basis of additional data. For current Clear Creek Gauge water temperature data see: https://www.cbr.washington.edu/sacramento/data/tc_clear.html

In other words, the best available science now confirms that winter-run Chinook salmon egg TDM is in a non-linear relationship with specific temperature thresholds; that TDM rates increase very rapidly at daily average temperatures above 53.5° F (11.94° C) (Martin *et al.* (2016) and (2020)); and that TDM can be expected to be above 70 percent when eggs are incubated at constant temperatures of 55° F (~12.8° C) or higher (see **Figure 1** below).

In short, new scientific evidence exemplified in the two Martin, *et al.* studies indicates that if Reclamation continues to operate Shasta Dam such that daily average river temperatures below the dam at the CCR gauge equal or exceed 55° F from May 15 to October 31, as allowed under the 2019 BiOp even as modified by the 2022 IOP for Critical years, then ESA-listed winter-run Chinook salmon egg survival rates will continue to be dangerously low. Such elevated water temperatures would also likely have similar deleterious TDM impacts on eggs of spring-run and fall-run Chinook salmon elsewhere in the Sacramento River.

Although the current CCR gauge 55° F daily average temperature target in the 2022 IOP fails to protect against extreme levels of egg mortality, it is also important to recognize that even the current 2022 IOP *does not actually require attainment of any temperature cap at all*. The 2022 IOP identifies only temperature “targets,” which are thus deliberately made non-enforceable.

This is why (as noted below) in future IOPs, and in the eventually adopted salmonid BiOp now under reconsultation, it is our strong recommendation that water temperature standards that are necessary to protect these key Central Valley salmon runs from extinction should be both required, and based on the best available science – which at the present time clearly supports the use of 53.5° F as an appropriate daily average temperature standard for protecting winter-run Chinook salmon egg incubation at the CCR temperature control point in the California Central Valley.

RECOMMENDATIONS

The Council has extensive experience applying biologically-based harvest models to management decision-making. Not only is it important to use the best available science and to seek the most accurate results, but this is also required under both the MSA and ESA. It is equally important to understand the limitations of the models and to characterize the uncertainty associated with model results and with management and monitoring capabilities. This allows us to make appropriate and conservative policy choices about how those results are to be applied to management decisions.

From our observation of recent CVP water operations, and in view of the dismal results for winter-run Chinook salmon egg-to-fry survival over the past several years, we are concerned that high levels of TDM will continue to occur to winter-run Chinook salmon below Keswick Dam without significant changes in operations of the Shasta Reservoir. Our concern also extends to similar adverse TDM impacts elsewhere within the Central Valley system on both spring-run and fall-run Chinook salmon, for similar reasons.

To help correct these problems, we provide the following recommendations:

NMFS:

- Continue to require the Martin *et al.* (2016) model as the basis for winter-run Chinook daily average maximum water temperature management below Shasta/Keswick Dam at least to the CCR gauge, particularly for the 2023 IOP and any future salmonid BiOps on CVP operations.
- Require the CVP's management to limit TDM of winter-run Chinook salmon to a maximum of 30 percent in critically dry years, and less in other water year types (as proposed in NMFS' [2017 RPA amendments](#)).
- Make the CVP's compliance with end-of-September, carry-over Shasta Reservoir water storage needs to protect winter-run Chinook salmon egg water temperature management control a requirement (not just merely a "target") for future IOPs and salmonid BiOps. These needs should take into account any additional storage capacity needed for additional water releases that support spring- and fall-run Chinook salmon.
- Further develop TDM models, in cooperation with the relevant other agencies, for both spring-run and fall-run Chinook salmon in the Sacramento River, which would be of great help in finding additional ways to also reduce temperature-dependent mortality of these other important Chinook salmon stocks.

SWRCB:

- Revise Water Rights Order 90-5 to update not only required winter-run Chinook salmon maximum daily average water temperature TDM thresholds and temperature control locations below Shasta Dam, but to assess and update similar water temperature standards that affect spring-run and fall-run Chinook salmon TDM elsewhere, especially in light of the Martin *et al.* (2016) model and the best available science, including improving measurement methodologies. The SWRCB's currently required water temperature standards to protect salmon eggs from TDM are simply out of date.
- Review the current river water temperature monitoring systems below Shasta Dam, as many of the temperature gauges used today are not now best technology, and assist the relevant agencies in that system's upgrade.
- In its approval process for Reclamation's annual Sacramento River Temperature Management Plan, require (not just set unenforceable "targets") Reclamation to provide sufficient end-of-September carry-over storage in Shasta Reservoir to meet cold-water temperature control needs for downstream salmon egg incubation in the following water year.
- Until Order 90-5 is updated, in the annual Sacramento River Temperature Management Plan approval process, require that Reclamation reduce water deliveries to Settlement and Exchange Contractors (which SWRCB has acknowledged are actions within

Reclamation's reasonable control, and therefore subject to Order 90-5),¹⁴ if necessary, in order to maintain Shasta Dam water temperature controls that protect endangered winter-run and other downstream Chinook salmon runs within the Sacramento River. In addition to the inadequate temperature control standards for spring- and fall-run Chinook, minimum flows must be taken into account which more greatly coincide with the amount of habitat available according to the river's elevation at particular flows."

- Limit winter-run Chinook salmon egg TDM to a maximum of 30 percent even in critically dry years as requested by NMFS in its proposed RPA amendment in 2017 (citation below).
- The SWRCB should require that the Sacramento River Temperature Management Plans submitted by Reclamation annually to the SWRCB also include modeling of temperature impacts on fall-run Chinook salmon as well as winter-run and spring-run Chinook salmon, and to ensure that the temperature management plan also protects fall-run Chinook salmon and the "salmon fishery." In recent years, Reclamation's modeling has not even mentioned, let alone modeled or analyzed, the temperature impacts of its operations on fall-run Chinook salmon that are vitally important to maintaining California's valuable fisheries.
- In revising Order 90-5, ensure that the revised order requires protection of spring- and fall-run Chinook salmon, not just endangered winter-run Chinook salmon, consistent with the existing requirement that it protect the "salmon fishery." The SWRCB also needs to reconsider, in accordance with the best available science, the impacts of similarly inadequate temperature control standards on fall-run and spring-run Chinook salmon, and to better protect both fall-run and spring-run Chinook salmon spawning areas from lethal water temperature TDM levels like those observed in recent years.

Reclamation:

- Establish and proactively maintain a precautionary buffer in CVP water operations to ensure there is enough carry-over storage of cold water available at the end of each water year in Shasta Reservoir to meet winter-run Chinook salmon temperature management TDM control needs as well as minimum flows necessary for spring- and fall-run Chinook in each following water year, and maintain necessary proper flow reduction management to prevent redd de-watering in each following water year. This necessarily means that maintaining adequate carry-over storage at Shasta Reservoir should be a much higher priority than it currently is. This also necessitates the continued use of precautionary 90

¹⁴ As the SWRCB has noted in letters to Reclamation, factors within the reasonable control of Reclamation include reducing water supply allocations to the CVP's water contractors, including settlement and exchange contractors:

To the extent that Reclamation delivers water under its own water rights, Reclamation's obligation to deliver water to its contractors does not take precedence over its permit obligations. Order WR 90-5 requires Reclamation to reduce releases to the extent reasonable and necessary to control water temperature. This permit condition is not and cannot be nullified by a contractual obligation. **Reclamation's water supply contractors are not entitled to more water under their contracts than Reclamation is authorized to deliver consistent with the terms and conditions of its water right permits and licenses.** (*State Water Resources Control Board, June 1, 2020, letter to Reclamation (emphasis added)*).

percent and 99 percent exceedance level hydrology scenarios for Reclamation modeling and planning to inform all future storage-based decisions.

- The Sacramento River Temperature Management Plans submitted by Reclamation annually to the SWRCB should include modeling of temperature impacts on fall-run Chinook salmon as well as impacts on winter-run and spring-run Chinook. As noted above, the fall-run Chinook are vitally important not only as a NMFS trust species, but also as the backbone of California's valuable salmon fisheries, which are greatly affected by Reclamation's CVP actions.
- Reclamation should first reduce water diversions by settlement and exchange contractors if it cannot otherwise meet its basic water temperature management obligations under Order 90-5, as these water diversions are within Reclamation's reasonable control, and such reductions are sometimes necessary to meet both ESA obligations and water quality standards.

In closing, the Council urges the SWRCB and Reclamation to develop and finalize a much stronger and much more precautionary plan to manage Shasta Reservoir in the future so as to ensure retaining each year the cold-water pool necessary to protect the eggs of Sacramento River-spawning winter-run Chinook and other Chinook salmon runs downstream from excessive redd TDMs. In the face of ongoing climate changes particularly, assuring that these most basic and valuable fisheries resources will be protected, and that California's ocean salmon fisheries will continue to provide food for America's tables, should be among your agency's highest priorities.

Thank you for your consideration of our comments, and we look forward to hearing from you on how best to work with your organizations toward these goals.

Sincerely,



Marc Gorelnik
Council Chair

KFG:kma

Cc: Council Members
Habitat Committee
Salmon Advisory Subpanel
Salmon Technical Team

Enclosures:

Figure 1
References/Citations

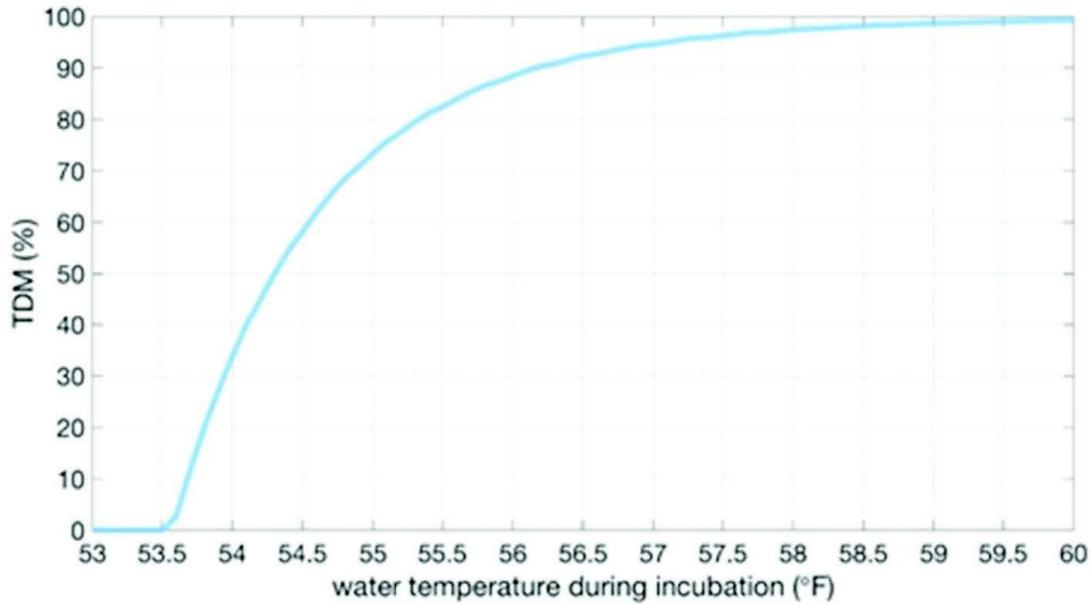
FIGURE 1

Figure 1: Temperature-dependent mortality (% TDM) of winter-run Chinook salmon eggs as a function of water temperatures, as modeled by NMFS based on research published by Martin et al. (2016). Note that eggs begin to die when exposed to constant temperatures above 53.5° F, and egg mortality increases rapidly (and non-linearly) as water temperatures increase. In particular, exposure to constant temperatures of 55° F corresponds to temperature-dependent mortality of greater than 70%. In the wild, temperatures are not constant; it is likely that TDM is higher at any given average temperature than it is at the corresponding constant temperature depicted here. (Source: Graph provided to *PCFFA et al.* parties by Federal defendants October 21, 2021. Taken from *Declaration of Dr. Jonathan Rosenfield, Ph.D.*, Case Doc. 325, pg. 20, filed December 16, 2021.)

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SWFSC Dec. 8, 2020, Water Year 2020 Winter-Run Chinook Temperature-Dependent Mortality Estimate)

SWFSC Oct. 24, 2021, Water Year 2021 Winter-Run Chinook Temperature-Dependent Mortality Estimate.