UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
West Coast Region
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Sacramento, California 95814-4700

JUN 01 2017

Mr. Pablo Arroyave
Acting Regional Director
Mid-Pacific Region
U.S. Bureau of Reclamation
2800 Cottage Way
Sacramento, California 95825

Re: 2017 Final Sacramento River Temperature Management Plan

Dear Mr. Arroyave:

Thank you for your May 23, 2017, letter transmitting the 2017 Final Sacramento River Temperature Management Plan (SRTMP). For purposes of compliance with the reasonable and prudent alternative (RPA) Action I.2.4[1], described in NOAA's National Marine Fisheries Service's (NMFS) biological opinion (issued June 4, 2009) on the long-term operations of the Central Valley Project and State Water Project (CVP/SWP Opinion), the U.S. Bureau of Reclamation (Reclamation) is required to submit a SRTMP to NMFS for concurrence. The SRTMP is required to meet a daily average water temperature (DAT) not in excess of 56°F at a compliance location between Balls Ferry and Bend Bridge from May 15 through September 30 for protection of Sacramento River winter-run Chinook salmon (*Oncorhynchus tshawytscha*), and not in excess of 56°F DAT at the same compliance location from October 1 through October 31 for protection of Central Valley spring-run Chinook salmon (*O. tshawytscha*), whenever possible. The objective of RPA Action I.2.4 is to manage the cold water storage within Shasta Reservoir and make cold water releases from Shasta Reservoir to provide suitable habitat temperatures for winter-run Chinook salmon, spring-run Chinook salmon, California Central Valley steelhead (*O. mykiss*), and the Southern distinct population segment of North American green sturgeon (*Acipenser medirostris*) in the Sacramento River between Keswick Dam and Bend Bridge, while retaining sufficient carryover storage to manage for next year's cohorts.

[1] http://www.westcoast.fisheries.noaa.gov/publications/Central_Valley/Water%20Operations/Operations,%20Criteria%20and%20Plan/040711_ocap_opinion_2011_amendments.pdf

Consultation History

On March 17, 2017, Reclamation sent NMFS water temperature modeling results and the initial water supply allocations for 2017 based on the 50% and 90% exceedance reservoir operations forecasts, and a data set that simulated meteorological conditions through the season at the historic average. Reclamation projected maintenance of release temperatures from Keswick Dam at 52°F through the entire management season, which is associated with the ability to manage DAT not to exceed 56°F between Balls Ferry and Jellys Ferry. Reclamation also projected that the pilot study target of 53°F DAT at the Clear Creek California Data Exchange Center gaging station (CCR) could also be achieved for the brood year 2017 temperature management season. Both the 50% and 90% exceedance forecasts projected end-of-September storage in Shasta Reservoir of at least 2.2 MAF.

On March 21, 2017, based on the projected end-of-September storage in Shasta Reservoir of at least 2.2 MAF and temperature model runs meeting a Balls Ferry temperature compliance point, NMFS concurred with Reclamation, that RPA Action 1.2.3.A should be implemented in Water Year 2017. In addition, NMFS committed to work with Reclamation to adjust the Keswick release schedules to minimize the potential for winter-run Chinook salmon redd dewatering and to stabilize flows for fall-run Chinook salmon spawning and egg incubation.

On April 12, 2017, Reclamation sent NMFS a response to the March 21, 2017 concurrence letter which clarified commitments for temperature management and Keswick releases. Specifically,

- Reclamation commits to, under the pilot study, meet a 53°F DAT near the Clear Creek confluence (measured at the "CCR" gaging station) but not a 55°F 7-day average of the daily maximum temperatures (7DADM) either at the CCR gage location, nor at the location of the downstream most winter-run redd.

- Reclamation did not commit to running the study through the entire winter-run emergence, but rather, stated that the end date needed to be a topic for future discussion.

- Reclamation noted that the projected Keswick release schedules were based on 50% and 90% exceedance forecasts and that actual flowrates were expected to vary within those ranges based on hydrologic and operational considerations at the time.

Reclamation's May 23, 2017, Sacramento River Temperature Management Plan

On May 23, 2017, Reclamation submitted its SRTMP to NMFS and requested concurrence that it was consistent with RPA Action I.2.4 in NMFS' CVP/SWP Opinion. In summary, Reclamation's plan consists of:

- Compliance point at Balls Ferry using the 56°F DAT metric from May 15 through October 31.
- Partial side gate use of the Shasta Reservoir Temperature Control Device would begin between late August and early September

- An evaluation study that will target 53°F DAT at the CCR gaging station during the same time frame. This acts as a surrogate location and temperature for 55°F 7DADM at the most downstream winter-run redd.

    - The study will evaluate the system-wide impacts of revised temperature management values, locations, and metrics on CVP operations, the environment, and/or impacts to other ESA listed species.
    - If redds are observed downstream of the CCR gaging station, the agencies will discuss potential changes to the evaluation study.
    - The study is anticipated to run through full winter-run emergence, but the duration may be re-evaluated based on other considerations such as anticipated fall and winter releases, storage and cold water pool management, and fall-run redd dewatering.

- Monitoring and tracking of the performance of the SRTMP through the Sacramento River Temperature Task Group (SRTTG), with the Shasta Water Interagency Management (SWIM) group convened only if necessary to address issues that can't be resolved by the SRTTG.

Summary and Expectations

The following are NMFS' summary conclusions and expectations based on Reclamation's proposed SRTMP:

- NMFS has reviewed Reclamation's proposed SRTMP. Within the range of hydrologic and meteorological scenarios modeled, the SRTMP is expected to provide generally suitable water temperatures for incubating winter-run Chinook salmon eggs and fry in brood year 2017.

- NMFS notes that Reclamation has been operating to achieve the 53°F DAT compliance point at CCR since May 2, 2017.

- Reclamation will operate in a manner to avoid any exceedance of 56.0°F DAT at Balls Ferry, and Reclamation will promptly implement steps to reduce the temperature to the compliance criterion to deal with any unforeseen transitions to periods of very high air temperatures and to assure that any exceedance is minimized.

- Enclosed is a summary document comparing the four SRTMP scenarios provided by Reclamation on May 23, 2017, to the 50% exceedance scenario provided on March 17, 2017.

    - Inputs from each scenario were used to generate daily average Sacramento River water temperatures using the River Assessment for Forecasting Temperatures (RAFT) model and associated temperature-dependent egg mortality, and survival estimates were generated using the NMFS temperature-dependent mortality model for the 2017 temperature management season.

- Mortality estimates assumed that redds would be distributed according to the composite distribution of redds observed 2012-2015.
- The document provides a summary plot, a summary table of temperature-dependent egg mortality estimates, and detailed plots for the temperature outlook and temperature-dependent mortality for each scenario.
- The RAFT model predicts that all scenarios generally meet the 56°F DAT compliance point at Balls Ferry for the duration of the season under proposed operations.
- The four May scenarios have a slight increase in estimated mean mortality (3.2-5.1%) compared to the March scenario (2%). The increase is most likely due to warmer Keswick discharge temperature after September (as seen in Figure 1 of the enclosure).

- The timing for reductions in flows in September and October shall be scheduled in coordination with the fish agencies to reduce the risk of dewatering existing winter-run or spring-run Chinook redds, and to discourage, to the extent possible, the spawning of fall-run Chinook redds in areas that could be dewatered when Keswick releases are reduced further later in the year.

In conclusion, NMFS concurs that Reclamation's proposed SRTMP is consistent with RPA Action I.2.4. We are making this finding based on the modeling results attached to Reclamation's May 23, 2017 letter, our understanding of the water temperature needs of winter-run Chinook salmon, results from the SWFSC application of the RAFT and NMFS temperature-dependent mortality models, and our conclusion that the potential effects of implementing the SRTMP in water year 2017 were considered in the underlying analysis of the CVP/SWP Opinion. Furthermore, the best available scientific and commercial data indicate that implementation of the SRTMP will not exceed levels of take anticipated for implementation of the RPA specified in the CVP/SWP Opinion.

We look forward to continued close coordination with you and your staff throughout this water year.

If you have any questions regarding this letter, please contact me at barry.thom@noaa.gov or (503) 231-6266, or Maria Rea at maria.rea@noaa.gov or (916) 930-3600.

Sincerely,

for Barry A. Thom
Regional Administrator

Enclosure

cc: California Central Valley Office
Division Chron File: ARN 151422SWR2006SA00268

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Summary Document for May 24th, 2017 Shasta/Keswick Operational Scenarios
Prepared by the Southwest Fisheries Science Center on May 25th, 2017

Below are results comparing the March 16th 2017 Input_50 scenario using historical meteorology to four scenarios received May 24th, 2017. Scenarios differ by hydrology (Input 50 or 90 percent exceedance) and air temperature (10 or 50 exceedance of L3MTO). Inputs from scenarios are used to generate daily average Sacramento River water temperatures using the RAFT model and associated temperature-dependent egg mortality and survival estimates using the NMFS temperature mortality model (Martin et al. 2017) for the 2017 temperature management season.

Further details of modeling methods are at: http://oceanview.pfeg.noaa.gov/CVTEMP/

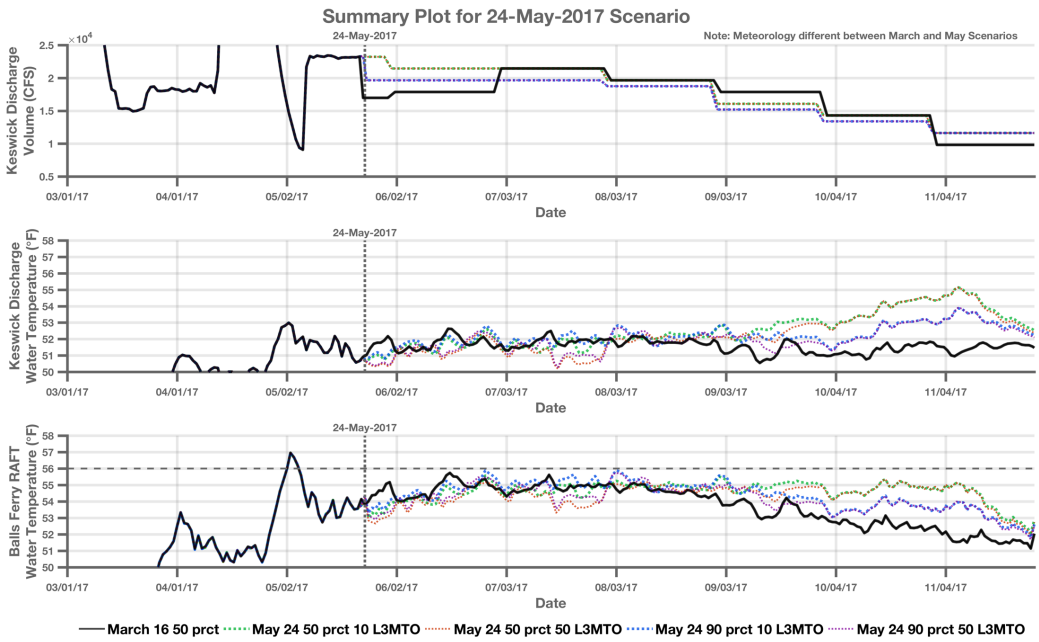

Figure 1: Summary plots showing differences in Keswick discharge volume and temperature, and Balls Ferry RAFT predicted temperature for five scenarios assessed.

Table 1: Estimated temperature-dependent egg mortality under different scenarios assuming a 2012-2015 spatial and temporal redd distribution.

Scenario	Mean (%)	Median (%)	Lower (%)	Upper (%)
March_16_2017_INPUT_50_OUTPUT_50	2.02	0.15	0.63	19.94
May_24_2017_INPUT_50_OUTPUT_50_10L3MTO	5.12	1.02	0.35	37.89
May_24_2017_INPUT_50_OUTPUT_50_50L3MTO	4.09	1.77	0.94	31.31
May_24_2017_INPUT_90_OUTPUT_90_10L3MTO	3.62	0.10	0.45	35.15
May_24_2017_INPUT_90_OUTPUT_90_50L3MTO	3.19	0.75	0.39	26.58

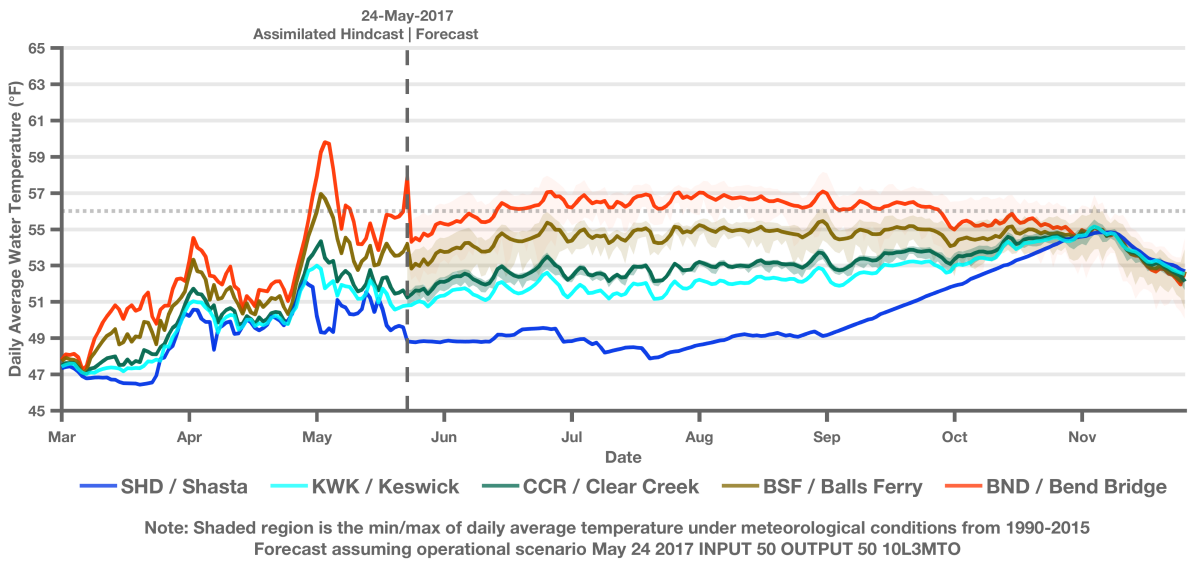

Figure 2: Estimated daily average water temperature produced by scenario input (Shasta and Keswick) and the RAFT model (Clear Creek, Balls Ferry, and Bend Bridge) under the May 24th 2017 Input_50_10_L3MTO scenario.

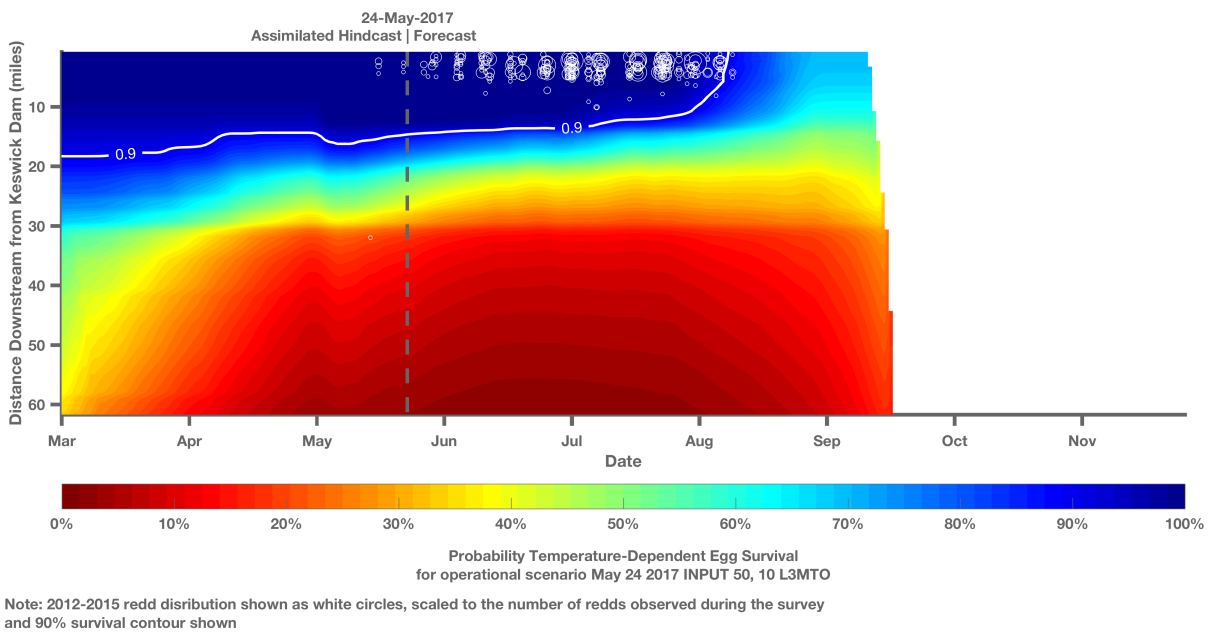

Figure 3: Estimated temperature-dependent egg survival produced by the NMFS temperature mortality model under the May 24th 2017 Input_50_10_L3MTO scenario.

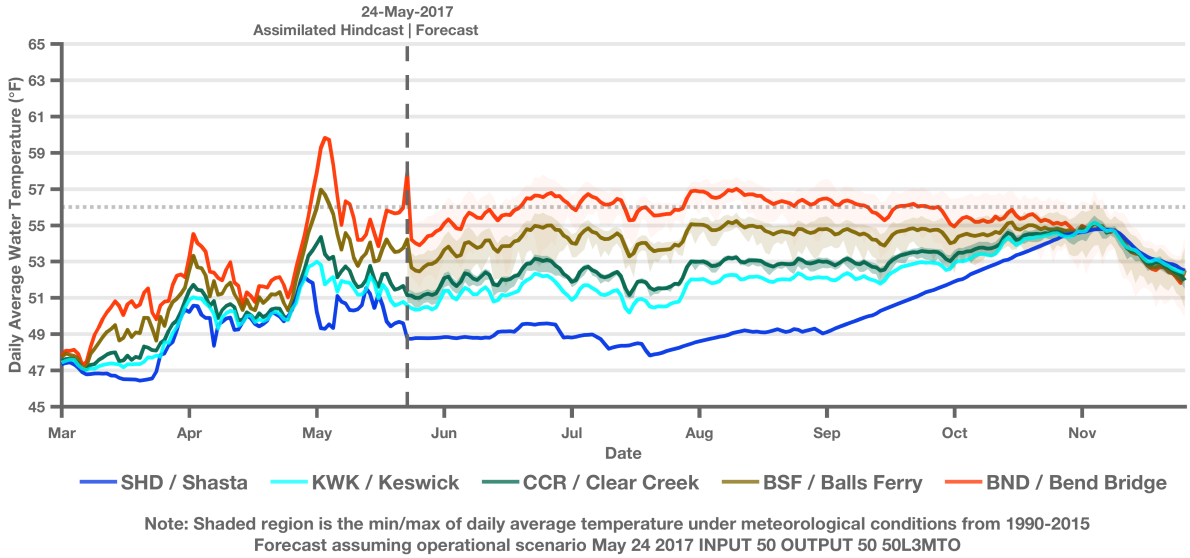

Figure 4: Estimated daily average water temperature produced by scenario input (Shasta and Keswick) and the RAFT model (Clear Creek, Balls Ferry, and Bend Bridge) under the May 24th 2017 Input_50_50_L3MTO scenario.

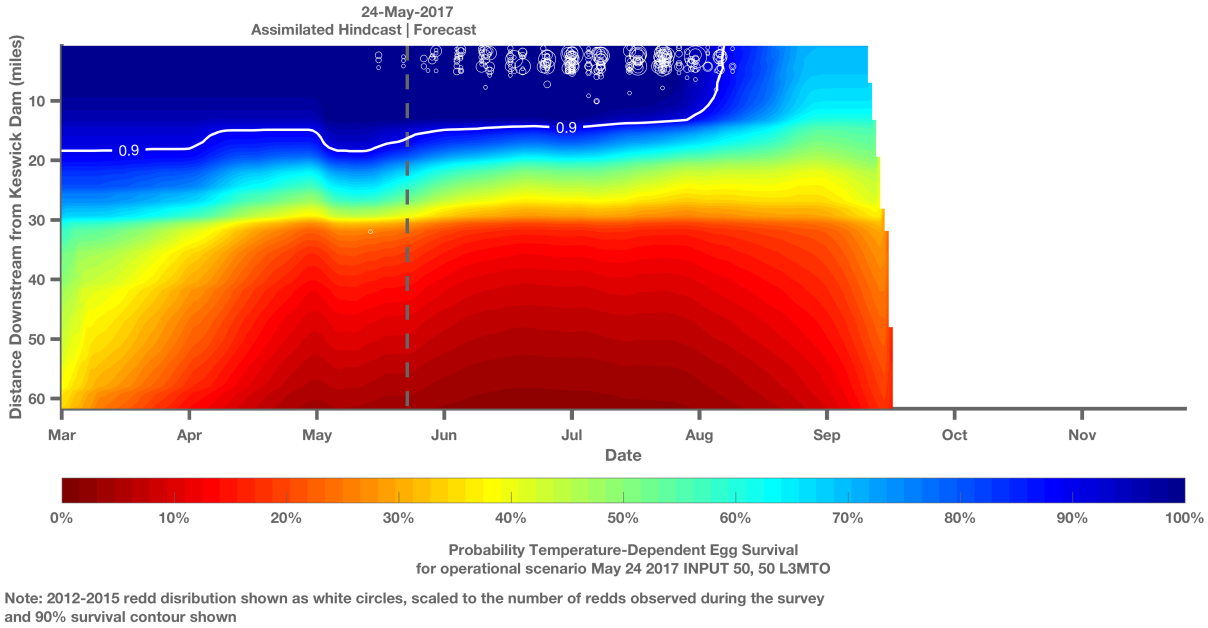

Figure 5: Estimated temperature-dependent egg survival produced by the NMFS temperature mortality model under the May 24th 2017 Input_50_50_L3MTO scenario.

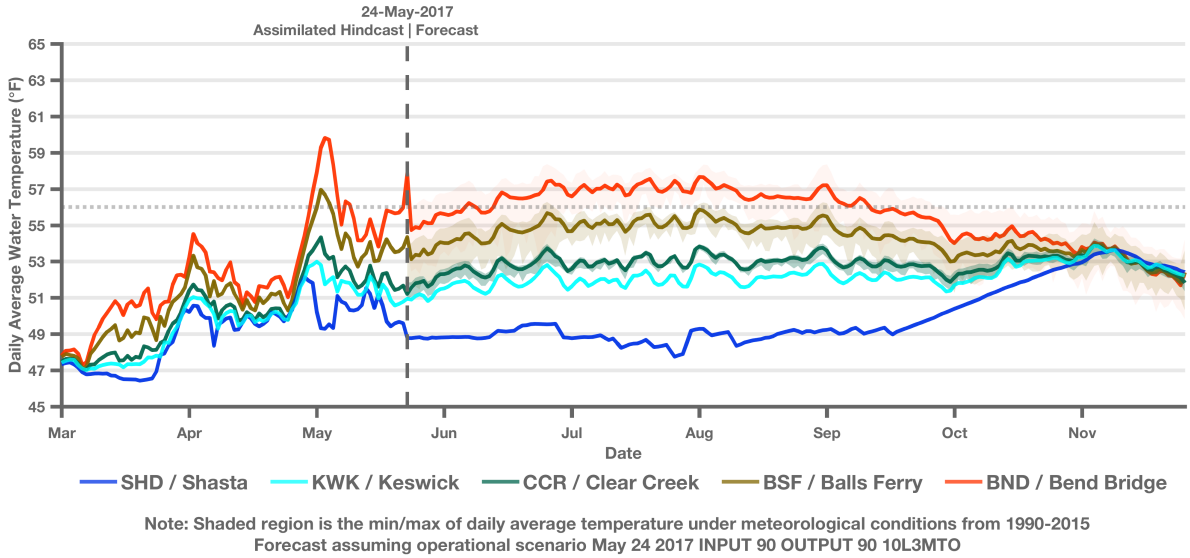

Figure 6: Estimated daily average water temperature produced by scenario input (Shasta and Keswick) and the RAFT model (Clear Creek, Balls Ferry, and Bend Bridge) under the May 24th 2017 Input_90_10_L3MTO scenario.

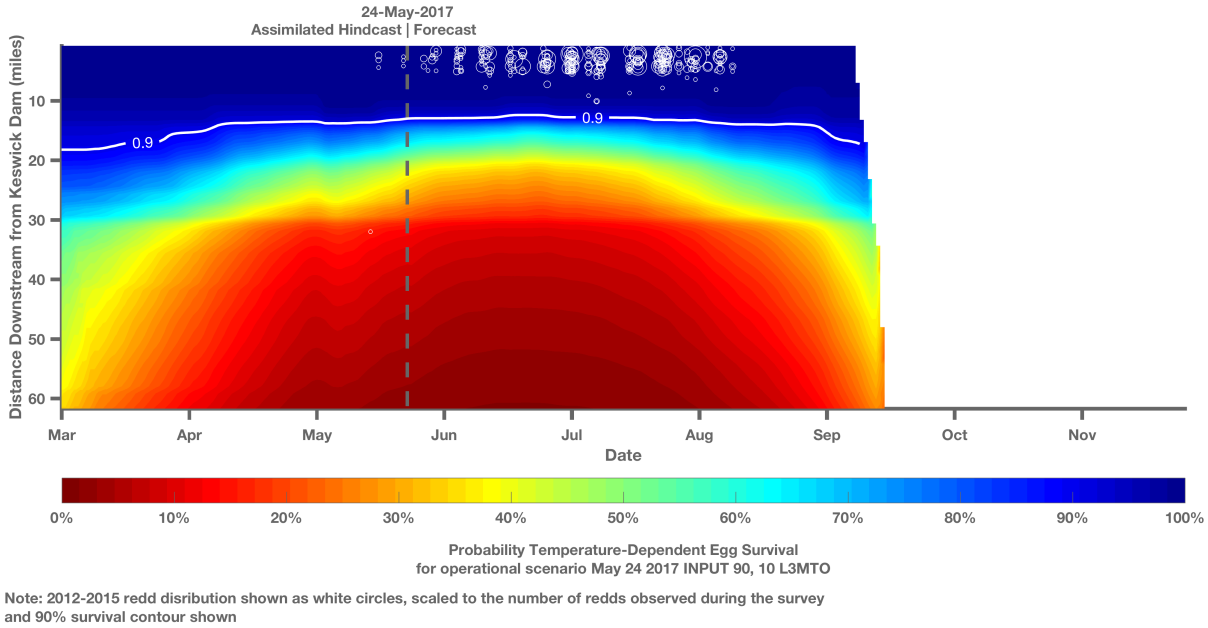

Figure 7: Estimated temperature-dependent egg survival produced by the NMFS temperature mortality model under the May 24th 2017 Input_90_10_L3MTO scenario.

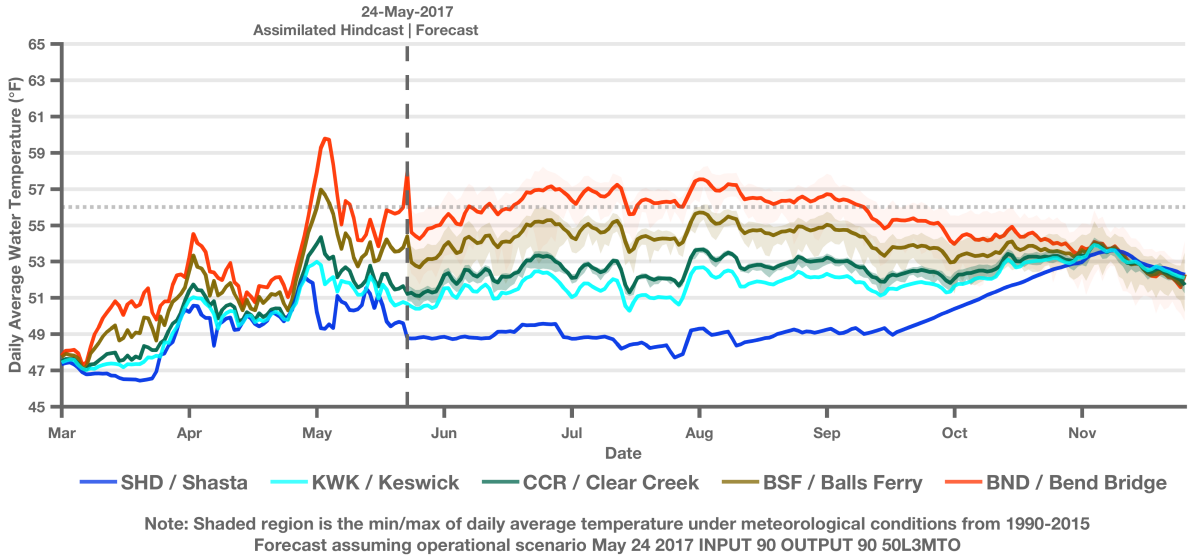

Figure 8: Estimated daily average water temperature produced by scenario input (Shasta and Keswick) and the RAFT model (Clear Creek, Balls Ferry, and Bend Bridge) under the May 24th 2017 Input_90_50_L3MTO scenario.

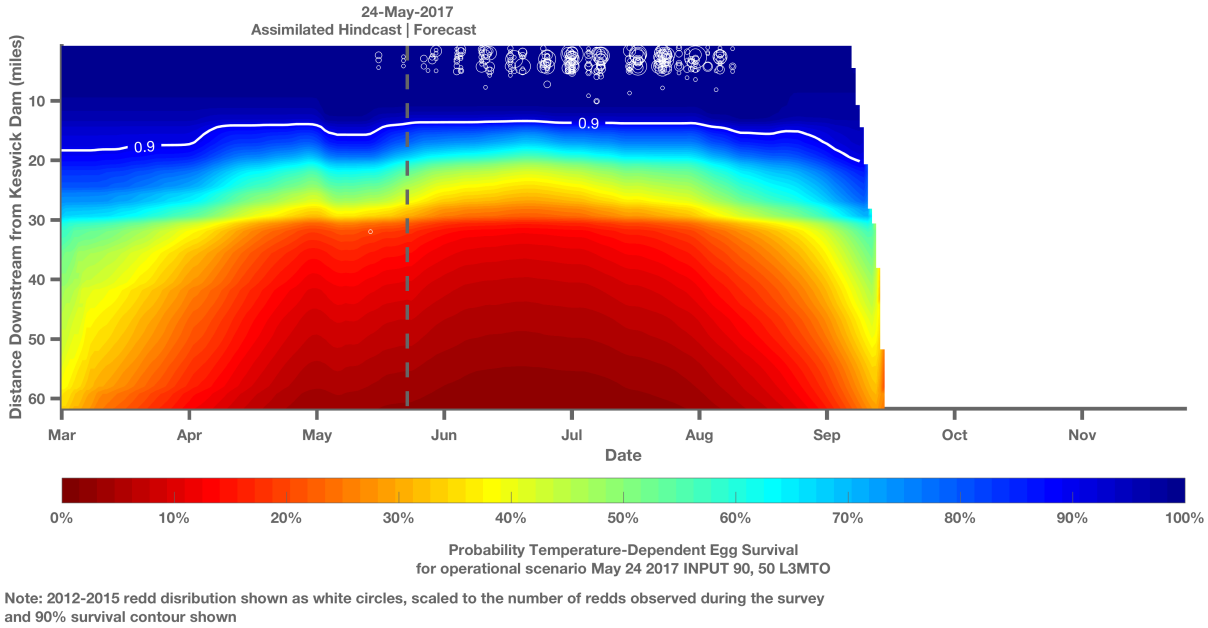

Figure 9: Estimated temperature-dependent egg survival produced by the NMFS temperature mortality model under the May 24th 2017 Input_90_50_L3MTO scenario.

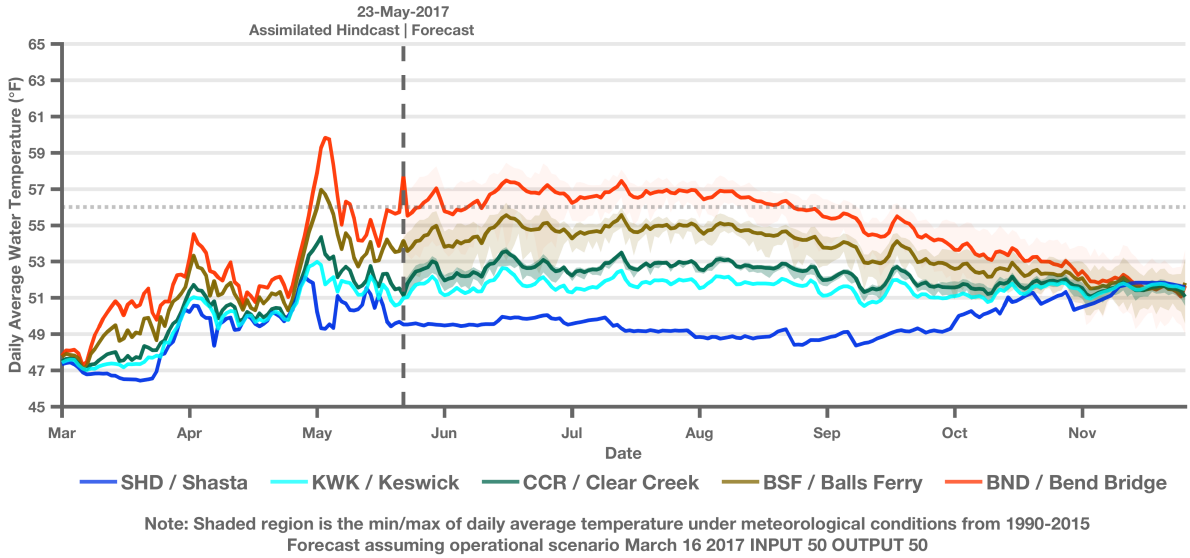

Figure 10: Estimated daily average water temperature produced by scenario input (Shasta and Keswick) and the RAFT model (Clear Creek, Balls Ferry, and Bend Bridge) under the March 16th 2017 Input_50 scenario.

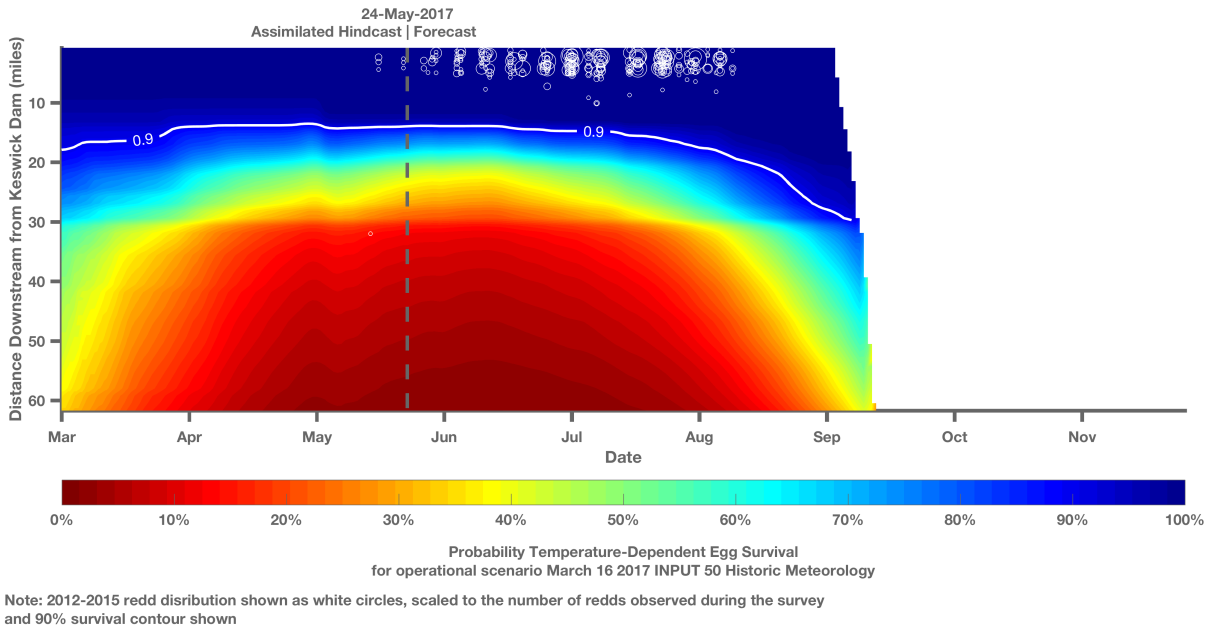

Figure 11: Estimated temperature-dependent egg survival produced by the NMFS temperature mortality model under the March 16th 2017 Input_50 scenario.

Reference:

Martin, B. T., Pike, A., John, S. N., Hamda, N., Roberts, J., Lindley, S. T. and Danner, E. M. (2017), Phenomenological vs. biophysical models of thermal stress in aquatic eggs. Ecology Letters 20: 50–59. doi:10.1111/ele.12705