

DRAFT TERMS OF REFERENCE

Revised Sacramento River Fall Chinook S_{MSY} through estimation of the S_{MP}

Review Meeting Dates: TBD

Location: Pacific Fishery Management Council Office, and online

Chair: TBD

BACKGROUND

Sacramento River Fall Chinook (SRFC) salmon constitutes an important ecological, cultural, and economic resource for the West Coast. Estimates of S_{MSY} (spawner abundance at maximum sustainable yield) play a central role in defining stock status, harvest control rules, and rebuilding analyses under the Pacific Salmon Fishery Management Plan (FMP) ([PFMC 2024](#)).

In [June 2023](#), the Pacific Fishery Management Council (PFMC) established the Sacramento River Fall Chinook Workgroup (SRWG) to re-evaluate approaches for estimating S_{MSY} , among a number of items related to SRFC management.

In reports provided by the SRWG and Council advisory bodies, it has been noted that direct estimation of S_{MSY} may not be possible due to the complication of accounting for the spawners in natural areas in the Sacramento River basin system. The Salmon Technical Team (STT) [expressed support](#) for an approach described in [SRWG 2024b](#), where a reasonable ratio between S_{MSY} and S_{MP} could be identified to inform a data-based estimate of S_{MSY} . As a part of an analysis presented to the Science and Statistical Committee (SSC) and STT in 2024, the SRWG described an approach to estimate S_{MSY} by first determining the S_{MP} (the escapement that maximizes production), and then from that value estimate the S_{MSY} using a ‘typical’ ratio between S_{MP} and F_{MSY} , where $S_{MSY} = F_{MSY} \times S_{MP}$ (see [SRWG 2024a](#) for more information). Subsequently, the Council requested the SRWG use this method for determining an updated S_{MSY} value. The SRWG has explored four potential datasets that could be used to estimate S_{MP} , and subsequently S_{MSY} via the ratio method.

Given the importance of SRFC to PFMC-managed fisheries, the PFMC now requests that an independent peer review panel (Panel) conduct a comprehensive review of the scientific merits of the ratio approach for re-estimating the S_{MSY} value ($S_{MSY} = F_{MSY} \times S_{MP}$) and the four different datasets identified by the SRWG, including their assumptions, uncertainties, and suitability, through a publicly accessible peer review process. The Panel may recommend an alternative to the ratio method (of determining a natural-area S_{MSY} by first estimating an S_{MP} and multiplying it by the F_{MSY}) if the Panel concludes it is not a scientifically sound methodology for re-estimating the SRFC S_{MSY} .

These Terms of Reference (TOR) define the requirements, timeline, and expected outputs for the peer review.

SCOPE

The objective of this peer review is to conduct a comprehensive review of the SRWG’s work related to updating the SRFC S_{MSY} value, develop a recommendation for consideration by the Council and its SSC for an approach to update the S_{MSY} value, and compare the scientific merits of the recommendation to the status quo S_{MSY} value.

1. The Panel will first review the scientific merits of the methodology to estimate S_{MSY} on the basis of the formula $S_{MSY} = F_{MSY} \times S_{MP}$ (ratio approach) and the approach to use a Ricker stock–recruit relationship for SRFC.

1a. Should the Panel determine that this approach is scientifically sound, it would then evaluate the four candidate datasets for determining the S_{MSY} (based on first estimating the S_{MP}), as described in the [SRWG Progress Report](#) and [Appendices](#) provided to the Council in November 2025. The different datasets analyzed by the SRWG are:

- **Natural-Origin Fry Passing Through the Lower Sacramento River** (updated and extended version of [Munsch et al. 2020](#))
Abundance estimated using juvenile survival and passage models.
- **Potential Natural-Origin Adults in the Absence of Fishing from Cohort Reconstruction** ([Chen et al. 2024](#))
Reconstructed run-size estimates and potentially direct stock–recruit modeling.
- **Sacramento Index \times Proportion Natural-Origin Spawners** ([O’Farrell et al. 2013; annual coded wire tag recovery reports](#))
Derivation of potential natural-origin adult spawner abundance in the absence of fishing using SI and the proportion of natural origin spawners.
- **Natural-Origin Juvenile Migrants at Red Bluff Diversion Dam (RBDD)** ([Voss and Poytress 2022](#))
Juvenile abundance indices for the Upper Sacramento derived from rotary screw trap estimates.

The Panel may recommend an approach for re-estimating S_{MSY} based on one of the datasets analyzed by the SRWG for estimating S_{MP} (and subsequently the S_{MSY}), or may recommend an approach that ensembles or modifies these datasets (such as by data truncation, down weighting, or time-blocking).

1b. If the Panel determines that $S_{MSY} = F_{MSY} \times S_{MP}$ framework or the application of a Ricker stock–recruitment relationship is not scientifically appropriate for re-evaluating SRFC S_{MSY} , it may, but is not required to, recommend alternative analytical approaches or may recommend the SRWG develop an alternative method.

2. The Panel should evaluate the scientific merits of any recommended methodology relative to those supporting the current (*status quo*) S_{MSY} value.

PEER REVIEW CHARGE

The peer review panel will do the following:

1. Review all materials provided to the Panel. Materials will be distributed at least four weeks prior to the scheduled meeting.
2. Submit a list of preliminary questions to the peer review Chair no later than two weeks before the first scheduled session. These questions should focus on the work completed to date and the materials provided and should not be requests for additional analyses. The Chair, in coordination with the Panel members, will compile and prioritize the questions and then forward a final list to the SRWG as soon as possible, but no less than one week prior to the meeting.
3. Travel to, attend, and actively participate in the review meeting.
4. At the first meeting, the Panel shall conduct a scientific review of the approach to re-estimate the SRFC S_{MSY} value using the approach $S_{MSY} = F_{MSY} \times S_{MP}$ and evaluate the suitability of a Ricker stock–recruitment function for characterizing the spawner–recruit relationship of SRFC.
5. If the Panel concludes the ratio approach is scientifically sound, the Panel will evaluate the approaches presented by the SRWG. The peer review panel should:
 - a. Identify strengths and weaknesses across the datasets.
 - b. Recommend a preferred dataset or explore the use of an approach that combines information across datasets, and include consideration of the implications of time series length, date range, and ocean and freshwater conditions for both statistical power and representativeness. The Panel may include recommendations to apply approaches such as data time series truncations, down weighting, or time-blocking techniques, if applicable. Additional considerations that could influence decisions regarding the appropriate range of years should be ranked by level of importance.
6. If the peer review panel determines that the ratio approach and/or use of a Ricker stock–recruit relationship is not scientifically sound, it may, but is not required to, recommend an alternative analytical approach. In some cases, evaluations may be addressed during the peer review panel session. In others, more extensive analysis that cannot be completed during the timeframe established for this peer review process may be required. The identification of analyses that can be completed during the peer review process (up to three sessions) shall be determined through consultation between the Panel Chair and the SRWG.
7. In cases where work cannot be completed within the three meetings permitted under these TOR, any Panel recommendations will be forwarded to the Council and its SSC through the Panel’s final report. In such situations, the Panel should provide clear

guidance and a well-defined recommended analytical framework for completing the work. The Panel would not conduct the analysis itself. Pursuant to the [NOAA Fisheries Framework for Determining that Stock Status Determinations and Catch Specifications are Based on the Best Scientific Information Available](#), the peer review panel is not required to review subsequent responses and revisions; however, any such responses and revisions should be well documented by the SRWG (if it is subsequently tasked with evaluating the Panel's recommendations by the Council). Should the Council, based on recommendations in the Panel's final report, task the SRWG with additional analysis following the conclusion of the peer review process, it may either extend the peer review or direct the SSC and STT to conduct a review of this work.

8. Provide a comparison of the recommended method (whether the ratio method or an alternative approach) with the scientific basis of the current (*status quo*) S_{MSY} value. This evaluation is not intended to re-examine or reanalyze the methods used to develop the status quo, but rather to compare the relative scientific merits of the existing approach to the methods recommended through this process.
9. Prepare and deliver a final consensus (or majority) Panel report including all findings, evaluations, and recommendations. This report will be submitted for consideration by the PFMC and its SSC.

STRUCTURE OF PEER REVIEW PROCESS AND MEETING(S)

The following provides a general description of the sequence of events and peer review sessions. The final schedule, meeting agendas, and topics for each session will be developed by the Panel Chair in coordination with Council staff.

Pre-Review Preparation

Panelists will receive peer review materials at least four weeks prior to the peer review.

At least two weeks prior to the scheduled peer review, each Panelists will submit preliminary questions or points requiring clarification on the work completed to date and the materials provided to the peer review panel Chair.

The Chair will review these submissions, coordinate with the Panelists to develop a consolidated list, and transmit the list to the SRWG as soon as possible, but no less than one week in advance of the first session. The SRWG will prepare responses to these questions and present them at the first peer review session to increase efficiency and ensure a focused discussion.

Initial Peer Review Session

The peer review will begin with a two-day in-person session, tentatively to be held at the Council office in Portland, Oregon. During this session, the Panel will receive an overview presentation from the SRWG on the background and methodological basis for the status quo and ratio approach

for estimating S_{MSY} , use of a Ricker stock-recruit relationship for SRFC, and other supporting information as needed. The SRWG will also address the questions submitted by the Panel members and distributed by the Chair prior to the first session.

The Panel will review the ratio approach presented and consider its suitability for application to SRFC. The review of the ratio approach may result in one of the following outcomes:

(1) The Panel recommends the ratio approach is scientifically sound. If so, it would then receive a presentation from the SRWG on the four candidate datasets and may recommend a preferred dataset or recommend the use of an approach that combines information across datasets (as described in the Panel Charge). No further review sessions would be necessary. The Panel Chair would conclude the session by outlining the plan for development of the final report.

(2) The Panel preliminarily supports the use of the ratio approach and begins to coalesce around one dataset or a modified approach but identifies the need for additional analyses, data exploration, or clarifications that cannot be completed during the initial session. At least one additional session would be held, to occur online approximately three weeks after the initial meeting to allow the SRWG sufficient time to prepare supplemental materials and submit them to the Panel five business days prior to the next session. The purpose of the follow-up session would be to review the additional information and move toward a final recommendation.

(3) The Panel recommends the ratio approach is not scientifically sound given the available datasets, management context, and/or basin characteristics. The Panel may either (a) recommend alternative methodological framework(s) for the SRWG to evaluate and present back to the Panel on at a future peer review session, (b) recommend the SRWG develop another approach for the Panel to consider at a future meeting, or (c) conclude the peer review meeting and document its conclusions in a report, including any recommendations for future consideration by the SSC and the Council.

Under scenarios (a) or (b), the feasibility of completing any additional analytical work would be discussed between the Panel Chair and the SRWG Chair to determine whether such work could be completed in time for a subsequent peer review session. The SRWG would prepare documentation in response to the Panel's recommendation, to the extent feasible given the short turnaround time available for comprehensive evaluation. The Panel would reconvene (online) to evaluate the SRWG's updated analyses approximately three weeks after the initial session. If needed, the Panel may request one further round of iteration, with the SRWG again providing updated information to be presented to the Panel at a third session that would occur approximately three weeks after the second.

Post-Review Report

After the conclusion of the review meeting(s), the Panel Chair, with input from all Panel members, will prepare a final written report that includes (1) a review of the use of the ratio approach ($S_{MSY} = F_{MSY} \times S_{MP}$) and Ricker stock-recruit relationship and recommendation on its suitability for use

in determining an updated S_{MSY} for SRFC; (2) as applicable, an evaluation of the datasets and approaches presented by the SRWG and a comparison to status quo and/or description of the alternative method recommended by the Panel and a comparison to status quo; (3) the Panel's recommended range of years to be used in the recommended approach for updating the S_{MSY} value and why; (4) summary of advisor contributions and comments; and (5) future recommendations and additional considerations, as appropriate.

If, after three peer review sessions, the Panel does not reach consensus on a single method for updating the S_{MSY} value, the final report should clearly describe the methods and datasets evaluated and identify the outstanding issues that prevented a consensus (or majority) recommendation from being reached. The report should also identify, as applicable, a set of narrowed options, clear recommendations on next steps, and further analysis needed to determine an updated SRFC S_{MSY} value given the currently available science and information. In its review of the report, the SSC will evaluate the Panel's findings and recommended next steps and determine whether an updated S_{MSY} value can be adopted as best scientific information available, or whether additional work is needed before making a recommendation to the Council.

PEER REVIEW PANELISTS

The Panel shall consist of one Chair and the number of panel members necessary to ensure the identified skills and expertise are represented. The Chair and Panel members will be identified and appointed by the Council Chair, in consultation with the Council. Panelists may include Alaska, Washington, Idaho, Oregon, and/or California Departments of Fish and Wildlife (maximum one per state), tribes, NMFS (one), the Center for Independent Experts (one), academia (one), or other individuals identified as independent experts. Collectively, the Panel shall possess expertise encompassing the following areas:

- knowledge of large river ecosystems and the influence of inland environmental conditions on salmon population dynamics, including river capacity constraints; hydrologic drivers, and freshwater survival processes relevant to major interior river systems;
- experience in salmon escapement estimation and/or participation in federally led watershed- or stock-assessment programs; and
- familiarity with West Coast salmon fisheries science, including assessment methodologies, harvest models, and scientific review processes.

The Panel Chair is responsible for:

- coordinating with Council staff on development of the meeting agenda;
- ensuring peer review panelists, SRWG members, and advisors adhere to the TOR;
- ensuring the meeting is conducted effectively and efficiently, maintaining focus on topics within the scope of the assessment review;

- moderating discussions, including inviting contributions from advisors and SRWG members when appropriate and limiting discussion to Panel members when necessary;
- guiding the Panel toward consensus or, where needed, clearly articulated majority and minority recommendations;
- preparing the final draft of the Panel Report (obtaining review and approval from Panel members and from the advisors on the section describing advisor contributions, providing the draft to the SRWG for review and comment, and submitting the final report to the Council by the established deadline);
- coordinating with the SRWG Chair, as necessary, on feasibility of Panel recommendations, clarification of technical assumptions, identification of data limitations, and consideration of alternative approaches or analyses;
- coordinating with the Council Executive Director regarding any need for interim updates to the Council on progress.

SACRAMENTO RIVER FALL CHINOOK WORKGROUP

The SRWG is responsible for preparing scientifically and technically sound reports and presentations to support the peer review process. This includes, but is not limited to, delivering a presentation on the first day of the review covering the background and methodological basis for the status quo approach (and most pertinent reviews of status quo completed to date, including relevant information provided during the 2022 Salmon Methodology Review) and the ratio approach, the use of a Ricker stock-recruit relationship for SRFC, and other supporting information as needed. The SRWG will also address the preliminary questions submitted in advance through the Panel Chair. In addition, the SRWG should be prepared to present information related to the derivation of S_{MSY} included in its November 2025 Council report and appendices (or updated versions of these reports).

The SRWG should be prepared to address subsequent questions received by the Panel related to SRWG work products and analysis.

The SRWG Chair is responsible for coordinating with the Panel Chair on issues such as, but not limited to, the feasibility of Panel recommendations, clarification of technical assumptions, identification of data limitations, and consideration of alternative approaches or analyses.

The SRWG shall prepare and provide materials in accordance with deadlines and procedures established in these TOR or as requested by the Panel Chair.

The SRWG shall respond to questions from the peer review panel and provide technical clarification as needed; however, it shall not participate in or influence Panel deliberations or decision-making.

PARTICIPATION OUTSIDE OF THE PEER REVIEW PANEL

Council Appointed Advisors:

The Council Chair will designate one or two representatives from each of the Scientific and Statistical Committee (SSC), Salmon Advisory Subpanel (SAS), and Salmon Technical Team (STT) to attend and sit with the peer review panel. These representatives will review all materials in advance of the meeting and may contribute to Panel discussions at the discretion of the Panel Chair.

The SSC representative will provide historical context and insight into SSC perspectives and help facilitate clear communication of panel discussions to the SSC in subsequent stages of the review. The STT representative will contribute technical expertise on West Coast salmon management and assist in evaluating the feasibility of approaches considered by the Panel. The SAS representative will help ensure that industry perspectives are communicated clearly and considered early in the process. (These roles are illustrative rather than exhaustive, and representatives may offer additional relevant insights and expertise, as appropriate, to support the Panel's work.)

Advisors do not take part in Panel deliberations or consensus development, ensuring the Panel's scientific conclusions remain independent and free from undue influence. The Panel Chair will include a summary of advisor contributions in the Panel Report, which advisors will have the opportunity to review prior to finalization.

Public Participation:

The peer review meeting is a public meeting and, although distinct from the role of Panel members and designated advisors, public attendance and participation of the public contributes to an open and transparent review process. The public may provide comment during the scheduled comment periods.

Participation in a public capacity outside of the peer review panel and official advisors may include, but is not limited to, members from:

- Governmental agencies non-Panel representatives: National Oceanic and Atmospheric Administration (NOAA) Fisheries, California Department of Fish and Wildlife, Oregon Department of Fish and Wildlife, Bureau of Reclamation, California Department of Water Resources
- Pacific Fishery Management Council: SSC, STT, Salmon Advisory Subpanel
- Indigenous representatives: Tribal governments and Indigenous fisheries organizations
- Other interested stakeholders and members of the public

MATERIALS TO BE PROVIDED

Prior to the review meeting, participants will receive:

- [SRWG Progress Report](#) and [Appendices](#) (November 2025), with updates if applicable
Relevant reports related to the Council's prior review of the status quo S_{MSY} value
- Scientific literature supporting the data sets described in the SRWG report
- Summary documentation of PFMC salmon management
- Agenda and list of participants

SCHEDULE AND MILESTONES

The initial two-day peer review meeting is tentatively planned to be held in mid to late June. The first milestone (distribution of working papers) would occur in late May.

All meeting dates will be tentatively established at the start of the peer review process, before the first meeting. Meetings will be spaced to allow sufficient time for additional work between sessions while still aiming to complete the process before the September Council meeting.

If the Chair, after consulting with the peer review panel, SRWG representatives, and Council staff, determines that additional time is needed, the interval between meetings may be extended. This may result in the peer review process or final report not being finished in time for the September Council meeting. If necessary, Council staff will revise the current schedule, as outlined in the most recent Year at a Glance, to accommodate the additional time needed for a thorough review.

- **Meeting -4 weeks:** Distribution of working papers.
- **Meeting -2 weeks:** Submission of preliminary questions to Chair.
- **Meeting -1 week:** Dissemination of curated preliminary questions from Chair to SRWG.
- **Meeting:** Two-day in person peer review meeting.
- **Meeting +3 weeks:** First additional one-day online session, if necessary.
- **Meeting +6 weeks:** Second additional one-day online session, if necessary.
- **November PFMC briefing book deadline (October 16, 2026):** Final publication of Peer Review Panel Report.

REFERENCES AND RELATED SOURCES

- Chen, E. K., W. H. Satterthwaite, M. R. O'Farrell, and S. M. Carlson. 2024. Cohort Reconstruction for Sacramento River Fall Chinook salmon and Comparison with the Sacramento Index. Report to Pacific Fishery Management Council. Available from: pcouncil.org/documents/2024/09/cohort-reconstruction-for-sacramento-fall-chinook-salmon-and-comparison-with-the-sacramento-index.pdf/
- Munsch, S. H., C. M. Greene, R. C. Johnson, W. H. Satterthwaite, H. Imaki, P. L. Brandes, and M. R. O'Farrell. 2020. Science for integrative management of a diadromous fish stock: interdependencies of fisheries, flow, and habitat restoration. *Canadian Journal of Fisheries and Aquatic Sciences* 77:1487-1504. Available from: <https://doi.org/10.1139/cjfas-2020-0075>
- O'Farrell, M. R., M. S. Mohr, M. L. Palmer-Zwahlen, and A. M. Grover. 2013. The Sacramento Index (SI). NOAA-TM-NMFS-SWFSC-512:1–41. Available from: https://storage.googleapis.com/nmfs_odp_swfsc/Publications/Files/TM/SWFSC/NOAA-TM-NMFS-SWFSC-512.pdf
- Pacific Fishery Management Council (PFMC), 2024. Pacific Coast Salmon Fishery Management Plan for Commercial and Recreational Salmon Fisheries off the Coasts of Washington, Oregon, and California as Revised through Amendment 24. PFMC, Portland, OR. 84 p.
- PFMC. 2025a. Proposed Process for Updating Sacramento River Fall Chinook Reference Points, Conservation Objective, and Harvest Control Rule, September 2025. Available from: [IR1 SRFC Management](#)
- PFMC. 2025b. Staff Report on Sacramento River Fall Chinook Fishery Management Plan Amendment Development, November 2025. Available from: pcouncil.org/documents/2025/10/g-4-attachment-1-staff-report-on-sacramento-river-fall-chinook-fishery-management-plan-amendment-development.pdf/
- Satterthwaite, Will. Literature Review for Sacramento River Fall Chinook Conservation Objective and Associated S_{MSY} Reference Point, October 2022. Available from: <https://www.fisheries.noaa.gov/s3/2024-04/2022Satterthwaite-LiteratureReview-SRFCObjective.pdf>
- SRWG. 2024a. Sacramento River Fall Chinook ad hoc Workgroup Methodology Review Material *Updated F_{MSY} Proxy and S_{MSY}/S_{MP} Ratio*, November 2024. Available from: <https://www.pcouncil.org/documents/2024/10/f-2-attachment-2-updated-fmsy-proxy-and-smsy-smp-ratio.pdf/>
- SRWG. 2024b. Sacramento River Fall Chinook ad hoc Workgroup Progress Report, June 2024. Report to Pacific Fishery Management Council. <https://www.pcouncil.org/documents/2024/05/e-1-a-srwg-report-1.pdf/>
- SRWG. 2024c. Sacramento River Fall Chinook ad hoc Workgroup Progress Report, November 2024. Report to Pacific Fishery Management Council. Available from: pcouncil.org/documents/2024/10/f-6-a-srwg-report-1-sacramento-fall-chinook-ad-hoc-workgroup-progress-report.pdf/
- SRWG. 2025a. Sacramento River Fall Chinook ad hoc Workgroup Progress Report, November 2025. Report to Pacific Fishery Management Council. Available from: <https://www.pcouncil.org/documents/2025/10/g-4-srwg-report-1-sacramento-river-fall-chinook-workgroup-progress-report.pdf/>
- SRWG. 2025b. Sacramento River Fall Chinook ad hoc Workgroup Progress Report Appendices, November 2025. Report to Pacific Fishery Management Council. Available from: <https://www.pcouncil.org/documents/2025/10/g-4-srwg-report-2-sacramento-river-fall-chinook-workgroup-progress-report-appendices.pdf/>
- Voss, S. D. and W. R. Poytress. 2022. 2020 Red Bluff Diversion Dam Rotary Trap Juvenile Anadromous Fish Abundance Estimates. Report of U.S. Fish and Wildlife Service to U.S. Bureau of Reclamation, Sacramento, CA. Available from: https://www.researchgate.net/publication/363414690_2020_RED_BLUFF_DIVERSION_DAM_ROTARY_TRAP_JUVENILE_ANADROMOUS_FISH_ABUNDANCE_ESTIMATES