Summer-Fall Habitat Action
2025 Comprehensive Monitoring Plan

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Prepared by

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Scope

The Summer-Fall Habitat Action (SFHA) is a suite of actions taken in the summer and fall to improve Delta Smelt habitat and food conditions, including Fall X2 and the summer-fall Suisun Marsh Salinity Control Gate (SMSCG) action (See CDWR 2024). Specific monitoring and action plans have already been developed for the SMSCG action (SMSCG monitoring plan 2025.docx), but not Fall X2 or the proposed alternative summer flow actions (Healy et al. 2025). The purpose of this document is to describe the integration of existing monitoring for summer-fall actions with monitoring Fall X2 and potential alternative outflow actions to assess the effectiveness of the entire suite of actions that will be implemented in 2025.

This plan focuses on high-level hypotheses and SFHA identified by the Delta Coordination Group in the 2025 Summer-Fall Habitat Action Plan. Project-specific monitoring plans contain ancillary hypotheses and predictions that will increase our understanding of the mechanisms behind the actions but may not directly address the goals of the action as a whole. See SMSCG monitoring plan monitoring.

Action - Fall X2

If 2025 is Above Normal or Wet, the ITP and Biological Opinion require the 30-day average of X2 to be less than or equal to 80 km for the months of September and October. Structured decision-making processes conducted in spring of 2025 are evaluating potential alternative actions that increase

outflow in summer, rather than fall. Summer outflow actions will differ in timing, but have similar hypotheses to the Fall X2 action.

Hypotheses:

1. Decreasing X2 and/or increasing Delta Outflow will increase the area of Delta Smelt habitat in Suisun Bay with appropriate temperatures, turbidity, and salinity.
2. Decreasing X2 and/or increasing Delta Outflow will increase biomass of calanoid copepods, specifically *Pseudodiaptomus forbesi* abundance in Suisun Bay through increased transport from upstream.
3. Increased habitat area, and increased food resources, will result in higher Delta Smelt growth and survival.
4. Increased outflow in summer will have greater benefits to Delta Smelt survival and population growth than increased flow in fall.

Action – SMSCG operations

If 2025 is Above Normal, the ITP requires 60 days of SMSCG operations targeting a salinity of 4 PSU at Belden's Landing. Agencies recommended that this operation be started Sept 1 or when Belden's reaches 4 PSU, whichever comes first, and continue for 60 days.

Hypotheses:

1. Operating the SMSCGs during the summer and fall will increase the duration and area of Delta Smelt habitat in Suisun Marsh with appropriate temperatures, turbidity, and salinity.
2. Operating the SMSCGs during the summer and fall will increase biomass of calanoid copepods, specifically *P. forbesi*, in Suisun Marsh through increased transport from upstream.
3. Operating the SMSCGs for 60 days consecutively will increase the area of appropriate Delta Smelt Habitat in Grizzly Bay, which will be cooler than habitat in Suisun Marsh.
4. Increasing habitat area and food resources in Suisun Marsh and Grizzly Bay will result in higher Delta Smelt growth and survival.

Metrics and Monitoring Methods

The hypotheses for the Fall X2 and SMSCG actions are all substantially similar, so they will be assessed using similar monitoring methods. The monitoring and evaluation program for the SFHA will leverage existing routine monitoring surveys, supplementing them as necessary, to evaluate our hypotheses. Sampling locations are shown in Figure 1 and Figure 2.

To address our first hypothesis (i.e., maximizing habitat), we will monitor temperature, turbidity, and salinity throughout the estuary with continuous sondes maintained by DWR and USGS. After the action, we will retrospectively model area of appropriate Delta Smelt habitat achieved with three-dimensional hydrodynamic models (SCHISM).

To address our second hypothesis (i.e., increasing copepods), we will monitor zooplankton biomass by combining data from the Environmental Monitoring Program, Summer Townet Survey, and Fall Midwater Trawl, along with supplemental sampling for the SMSCG action.

To address our third hypothesis, (i.e., the extent to which habitat in Grizzly Bay improves), we will rely monitoring stations in Grizzly Bay and at the mouth of Tule Red restoration site on the edge of Grizzly Bay, along with retrospective models of area of appropriate Delta Smelt habitat.

Our fourth hypothesis, the effect of increased habitat on Delta Smelt, is the hardest to directly evaluate. We will use data from the Enhanced Delta Smelt Monitoring Program (EDSM) to evaluate the distribution of Delta Smelt, and where possible, condition of Delta Smelt, to see whether improved habitat conditions lead to improved Delta Smelt health. Due to the low numbers of Delta Smelt caught by EDSM in recent years, in 2025 DWR will be partnering with Cramer Fish Sciences to conduct a pilot study using environmental DNA to increase our probability of detecting Delta Smelt.

Site Description

The geographic focus of this workplan is on Suisun Marsh, Grizzly/Suisun Bay, and the lower Sacramento River. However, we also include the low salinity zone (LSZ, or area with salinity levels ranging 0.5 to 6 PSU) and

freshwaters in the North Delta upstream of the LSZ to put Delta Smelt habitat needs into a broader context consistent with recent reports and conceptual models (Brown et al. 2014, IEP-MAST 2015). This workplan focuses on the months of the action (June-October) and the months immediately before and after the action. IEP monitoring and other studies have been ongoing in the SFE for many years providing the opportunity to put the current workplan into a broader temporal context.

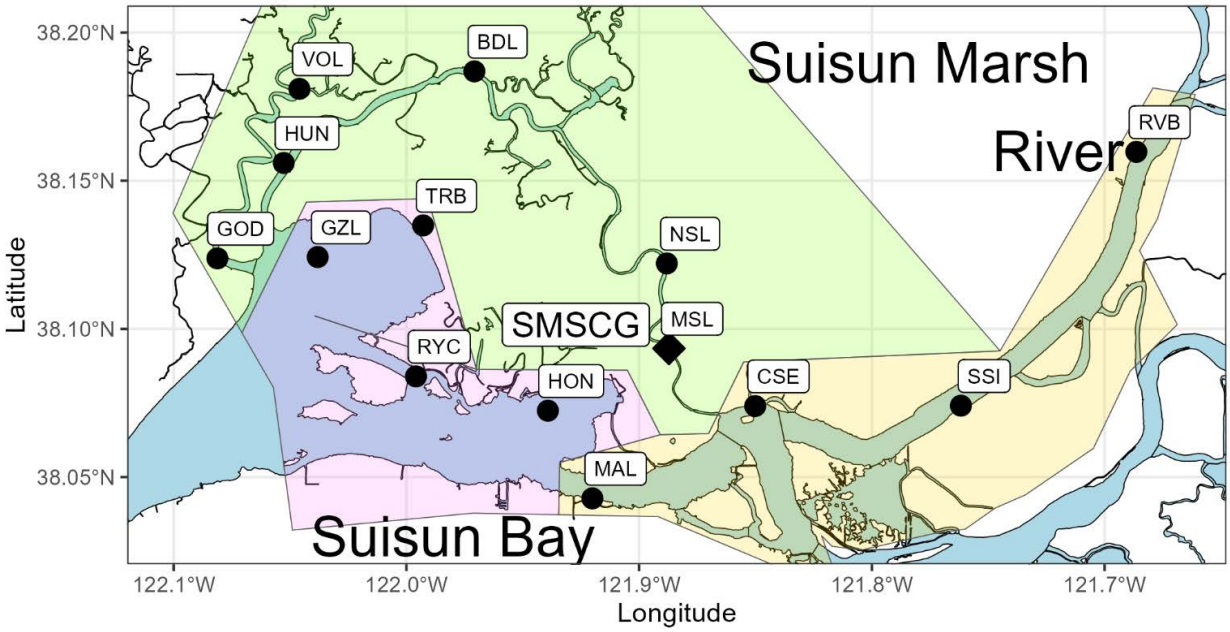


Figure 1 Water quality monitoring stations. Three regions used for major comparisons are outlined.

Habitat Modeling

After the action, we will model the area of habitat with appropriate salinity, temperature, and turbidity for Delta Smelt using the Bay-Delta SCHISM model, which is based on the Semi-Implicit Cross-scale Hydroscience Integrated System Model (SCHISM) (Zhang et al. 2016). The SCHISM hydrodynamic algorithm is based on mixed triangular-quadrangular unstructured grids in the horizontal and a flexible coordinate system in the vertical (Zhang et al. 2015). The DWR application of SCHISM to the Bay-Delta as well as a regional description of performance is described in Ateljevich et al. (2014) and Ateljevich et al. (2015). Model applications for some proposed SMSCG operations have also been included in the documentation of the Incidental Take Permit for the SWP (DFW 2024).

We will use the SCHISM model to produce the area below 6 PSU that also has water temperature of 22°C or lower, similar to the metric used in the DCG decision-making process. Temperature and turbidity may be interpolated from discrete water quality monitoring stations and/or data collected from continuous sondes.

Water Quality Monitoring

Suisun Bay, Suisun Marsh, and the lower Sacramento River region are already relatively well-monitored by routine and long-standing IEP surveys, which collect water quality, phytoplankton, zooplankton and benthic invertebrate samples on a monthly basis. DWR's water quality monitoring team maintains a number of water quality stations with continuous sondes in the LSZ and Suisun region (Table 1, Figure 1). In 2021, three new sondes were placed in Grizzly Bay, as per the requirements in the 2020 ITP, but after four years of data, analyses showed they did not provide significantly different information from the existing stations, so these stations were removed in 2025. Sondes are calibrated and exchanged per their organization's Quality Assurance Project Plans. When sondes are serviced, a discrete water sample is collected and sent to DWR's Bryte laboratory for analysis of chlorophyll-a and nutrients.

Table 1 Water quality monitoring stations. All stations collect data every 15 minutes for salinity, temperature, dissolved oxygen, and turbidity. Stations marked with an asterisk also have pH, and chlorophyll and phycocyanin fluorescence. Asterisked stations also have samples for nutrient and chlorophyll-a analysis collected every two weeks or monthly.

Station	Owner	Region	Location
CSE*	DWR	River	Montezuma Slough at Collinsville
EMM	USBR	River	Sacramento River at Emmenton
MAL	DWR	River	Sacramento River at Mallard Island
RVB	DWR	River	Rio Vista
MSL*	DWR	Marsh	Montezuma Slough near SMSCG Facility
NSL*	DWR	Marsh	Montezuma Slough at National Steel
BDL*	DWR	Marsh	Montezuma Slough at Belden's Landing
HUN*	DWR	Marsh	Montezuma Slough at Hunter Cut
GZL*	DWR	Grizzly Bay	Grizzly Bay Piling
TRB*	DWR	Grizzly Bay	Tule Red Restoration Site near breach

Biological Monitoring

Fish monitoring will rely entirely on existing surveys conducted by IEP, specifically the California Department of Fish and Wildlife (CDFW) Summer Townet Survey (STN), San Francisco Bay Study, and Fall Midwater Trawl Survey (FMWT), as well as the UC Davis Suisun Marsh Survey and the USFWS Enhanced Delta Smelt Monitoring Program (EDSM) (Figure 2). EDSM is currently the only survey that catches Delta Smelt on a regular basis. Because we are relying entirely on existing monitoring programs, each of which has limited sampling in our area of interest, statistical analysis of the effect of summer-fall SMSCG operations on community composition may not be possible until multiple action years are combined, though the analyses of Beakes et al. (2021) may provide a template for future work. Please refer to survey web sites for full details.

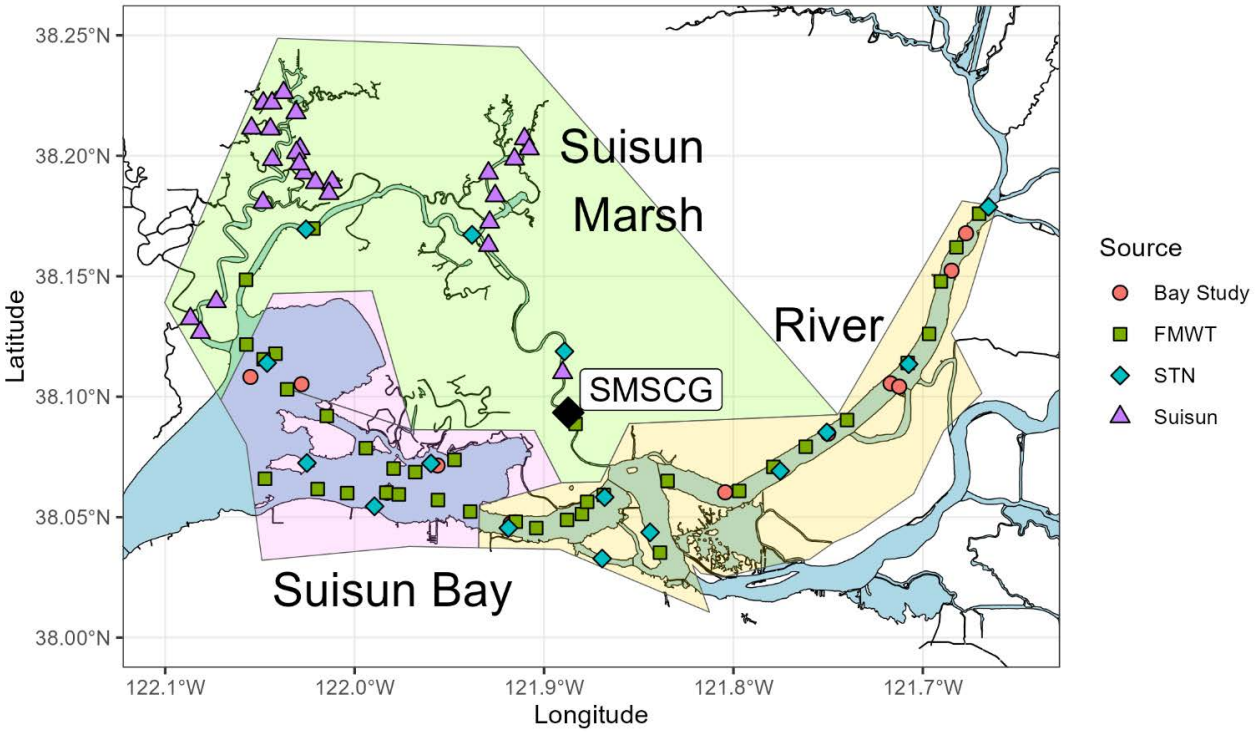


Figure 2 Sampling sites for IEP's long-term fish monitoring surveys. FMWT = Fall Midwater Trawl. STN = Summer Townet Survey, Bay Study = CDFW San Francisco Bay Study, Suisun = UC Davis Suisun Marsh Fish Survey.

Zooplankton will be monitored primarily using three existing IEP surveys, including the CDFW STN and FMWT (described above), as well as the

DWR/CDFW Environmental Monitoring Program (EMP)(Kayfetz et al. 2020). Additional sampling is conducted specifically for this management action to increase the spatial and temporal resolution of data in the area of interest. See Figure 3 for a map of all fixed stations. Previous years included supplemental monitoring from the USBR Directed Outflow Project (DOP), but this survey was discontinued in 2023 to focus on other research needs.

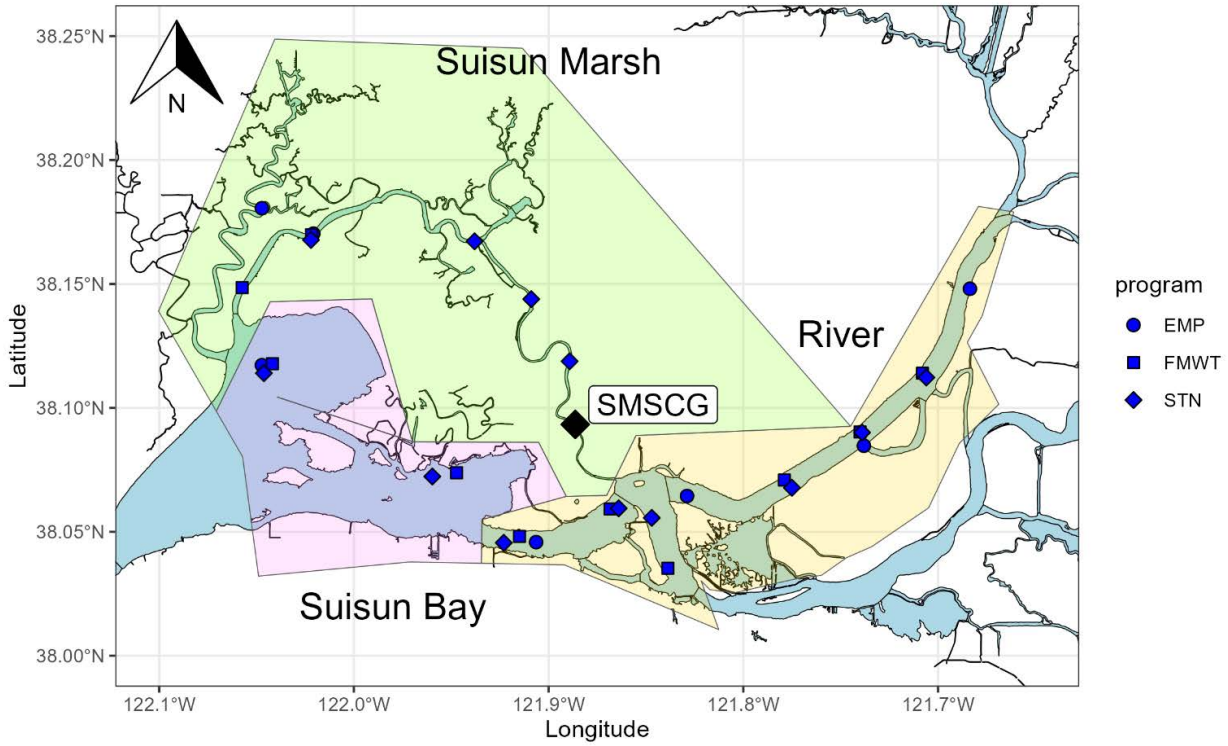


Figure 3 Zooplankton sampling locations

Environmental DNA pilot study

Due to the difficulty in detecting Delta Smelt in regular fish monitoring surveys, in 2025 we will be piloting the use of environmental DNA (eDNA) technology to improve our detections of Delta Smelt in Suisun Marsh and Suisun Bay during summer-fall. Use of eDNA methods was a recommendation from the 2024 Independent Review of the SFHA Science Plans and has been explored for smelt species in recent years (Bowen et al. 2024, Nagarajan et al. 2024). In collaboration with Cramer Fish Sciences, DWR plans to implement a pilot study to sample six sites in Suisun Marsh and the Lower Sacramento River (e.g., 3 sites in each region) every two weeks throughout the summer-fall study period (June – October). Rapid sample processing will determine the presence or absence of Delta Smelt,

Pseudodiaptomus forbesi (as a positive control), and Mississippi Silversides (as another control) in each tow sample. We will also test two different sampling methods (Sterevex versus tows) and use a deadcar experiment to assess how eDNA will disperse from a given location (Bowen et al. 2024). The findings of these pilot studies are anticipated to produce recommendations for future eDNA monitoring for Delta Smelt and may help inform long-standing hypotheses and uncertainties for the Delta Smelt Summer-Fall Action.

Data analysis

We will rely on three primary comparisons:

1. Inter-annual comparisons − We will compare constituents during 2025 to conditions in previous wet years with X2 actions (2017, 2019, 2023, 2024), previous years with SMSCG actions (2018, 2023, 2024) and dry years with no action (2020-2022).
2. Regional comparisons − We will compare habitat and prey conditions in Suisun and Grizzly Bay to conditions in Suisun Marsh and conditions in the lower Sacramento River; we will also compare the Delta Smelt performance indicators described above between Suisun Marsh, the lower Sacramento River, and, if possible, Grizzly Bay
3. Action/no action modeling − Where possible, we will use modeling to describe what habitat and prey conditions would have looked like without the action.

We will graphically compare the area of appropriate Delta Smelt habitat in Suisun Marsh and Suisun Bay (using the habitat suitability index developed by the DCG) to upstream and downstream regions using data from continuous monitoring stations maintained by DWR and USGS. We will also retrospectively model the area of appropriate Delta Smelt habitat using SCHISM models. We will compare this to conditions in previous years with varying hydrologic conditions. Increased duration and/or area of suitable temperature, turbidity, and salinity in Suisun Marsh would support the hypothesis that the SMSCG action increased Delta Smelt habitat. Increased duration and/or area of suitable temperature, turbidity, and salinity in Suisun Bay would support the hypothesis that the X2 or outflow action increased Delta Smelt habitat. If possible, we will also incorporate analyses

in Smith and Nobriga (2023) on impact of prey density on Delta Smelt habitat for a more complete metric of habitat availability and quality.

We will statistically compare biomass of *P. forbesi* and other Delta Smelt prey items in Suisun Marsh and Grizzly Bay in 2025 versus years with different salinity conditions using generalized linear models. We will also compare biomass of Delta Smelt prey in upstream areas versus the Low Salinity Zone. Increased zooplankton biomass in Suisun Marsh during 2025 and other years with low salinity would support the hypothesis that operating the SMSCGs increases food availability for Delta Smelt. Increased zooplankton biomass in Suisun Bay and Grizzly Bay during 2024 and other years with low salinity would support the hypothesis that the X2 or outflow action increases food availability for Delta Smelt.

We do not anticipate enough catch of Delta Smelt in the EDSM survey to statistically analyze changes in wild Delta Smelt abundance, condition, or distribution. However, we will graphically present data on Delta Smelt catch by region to see whether they are using habitat in Grizzly Bay, Suisun Bay, and Suisun Marsh which has been made available by the outflow and SMSCG actions.

We will plot salinities at stations in Grizzly Bay and use time series analysis to see whether SMSCG operations cause a decrease in salinity at these stations. If salinities at these stations drop when the gates are operated, it will support our hypothesis that gate operations can improve Delta Smelt habitat in Grizzly Bay.

Reporting

Monitoring results will be synthesized in the succeeding Summer-Fall Habitat Action Seasonal Report, as available. Habitat and water quality analyses will be included; however, biological data may not be available until early 2026. Updates on the analyses and final products will be presented to the DCG on a regular basis. Comprehensive monitoring will help to inform the Delta Coordination Group of the effectiveness of summer-fall actions (e.g., Fall X2, SMSCG and 100 TAF actions), refine structured decision-making performance measures, and enhance the adaptive management of the Summer-Fall Habitat Action in 2026. Reporting timeline subject to change:

- Draft report Dec 31, 2025
- Final report May 1, 2026

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