Summer-Fall Habitat Action – Comprehensive monitoring plan for 2023

California Department of Water Resources

Division of Integrated Science and Engineering

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Scope

The Summer-Fall Habitat Action is a suite of actions taken in the summer and fall to improve Delta Smelt habitat and food conditions, including Fall X2, the Suisun Marsh Salinity Control Gate (SMSCG) action, the extra 100 thousand acre feet (TAF) block of water, and the North Delta Food Subsidy (NDFS) action (See CDWR 2023a). Specific monitoring and action plans have already been developed for the SMSCG action and NDFS action (CDWR 2022, 2023b), but not Fall X2 and the 100 TAF action. The purpose of this document is to describe the integration of existing monitoring for summer-fall actions with monitoring for Fall X2 and the 100 TAF action to determine the effectiveness of the entire suite of actions that will be implemented in 2023.

This plan focuses on high-level hypotheses and goals for the Summer-Fall Habitat Action identified by the Delta Coordination Group in the 2023 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 and NDFS monitoring plan for details.

Action - Fall X2

If 2023 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.

Hypotheses:

1. Decreasing X2 will maximize the area of Delta Smelt habitat with appropriate temperatures, turbidity, and salinity, which will result in higher Delta Smelt growth and survival.
2. Decreasing X2 will increase biomass of calanoid copepods in the low salinity zone through increased transport of freshwater species from upstream, which will result in higher Delta Smelt growth and survival.

Action - 100 TAF of outflow

In 2023, the 100 TAF block of outflow will be deployed to operate the SMSCGs starting on August 15th, or when the salinity at Belden's Landing reaches 4 PSU, whichever is first, and continuing until October 22nd. The goal of this action is to expand freshwater habitat spatially and temporally for as long as possible during summer-fall months using 100 TAF outflow block. Doing this may provide some refuge from warm water temperatures by increasing access to more suitable habitat conditions in the marsh and Grizzly Bay (e.g., cooler water, higher turbidity and possibly, elevated prey density) that may be much less suitable in most inland locations when lower outflow and higher salinity compel the Delta Smelt population to mainly inhabit the legal Delta.

Hypotheses:

1. Operating the SMSCGs during the summer and fall will maximize the duration and area of Delta Smelt habitat with appropriate temperatures, turbidity, and salinity that can be accomplished with 100 TAF of water, which will result in higher Delta Smelt Growth and survival.
2. Operating the SMSCGs during the summer and fall will increase biomass of calanoid copepods in Suisun Marsh through increased transport of freshwater species from upstream, which will result in higher Delta Smelt Growth and survival.
3. Operating the SMSGs will increase the area of appropriate Delta Smelt Habitat in Grizzly Bay.

Action — SMSCG operations

Because 2023 is a Wet year, no summer-fall SMSCG action is required by the ITP except the action made possible ty the extra 100 TAF block of outflow.

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2. Operating the SMSCGs during the summer and fall will increase biomass of calanoid copepods in Suisun Marsh through increased transport of freshwater species from upstream, which will result in higher Delta Smelt Growth and survival.
3. Operating the SMSCGs will increase the area of appropriate Delta Smelt Habitat in Grizzly Bay.

Metrics and monitoring methods:

The hypotheses for the Fall X2, 100TAF, 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. If feasible, we will retrospectively model area of appropriate Delta Smelt habitat 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. If possible, we will apply models of zooplankton transport (Kimmerer et al. 2018, Hassrick et al. 2023) to identify the mechanism behind increase in zooplankton biomass.

To address our third hypothesis, (i.e., the extent to which habitat in Grizzly Bay improves), we will rely on newly established monitoring buoys at the mouth of Montezuma Slough, the center of Grizzly Bay, and at the mouth of Tule Red restoration site on the edge of Grizzly Bay.

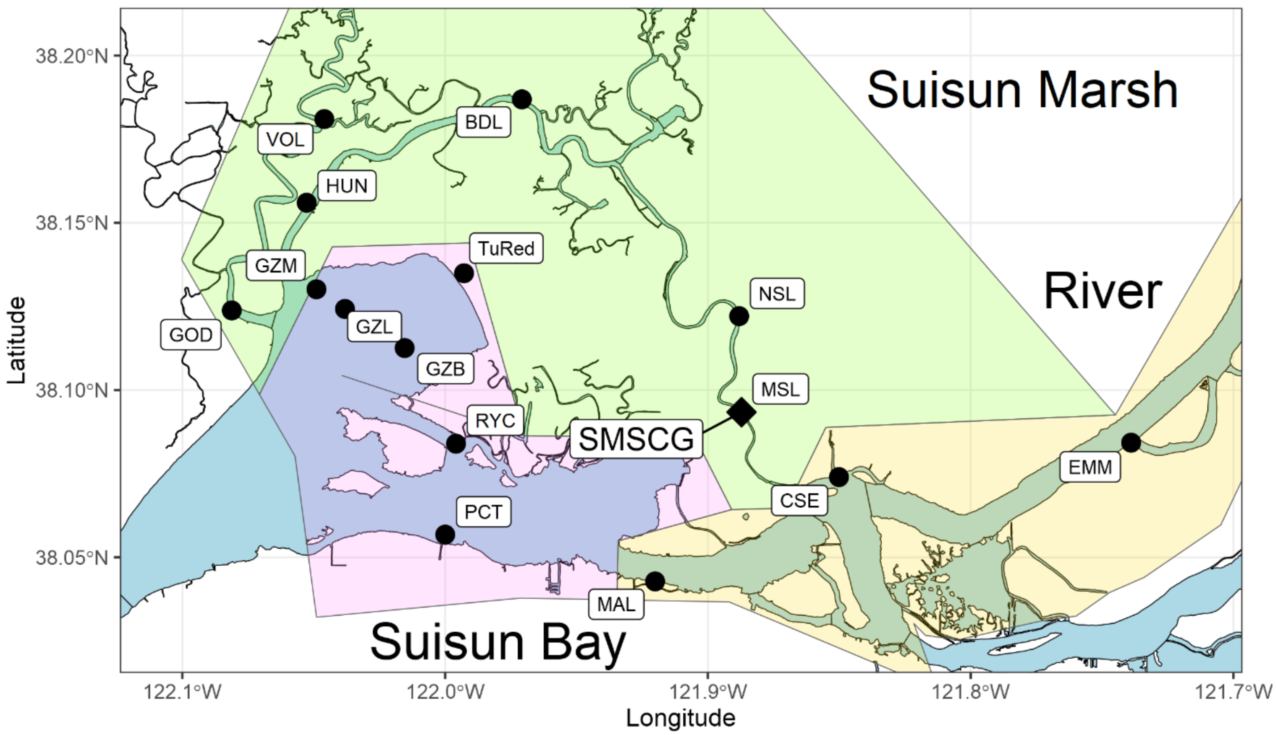
We will use data from the Enhanced Delta Smelt Monitoring Program to evaluate the distribution of Delta Smelt, and where possible, condition of Delta Smelt, to see whether improved habitat conditions lead to improve Delta Smelt health.

We will use Delta Smelt in enclosures (cages) at Rio Vista (where high heat and low turbidity may limit smelt growth), in Suisun Marsh (higher turbidity, lower temperatures, and low salinity), and at the edge of Grizzly Bay in higher salinity (~6 PSU) to test which (if any) habitat attributes are limiting Delta Smelt growth in the fall.

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 a salinity 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. However, 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. The three regions used for major comparisons are outlined. Additional data collected in Grizzly Bay will help better understand the spatial extent of the SMSCG influence.



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). A forthcoming paper by Smith and Nobriga may allow zooplankton abundance and day length to be added to this analysis. 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 2020).

We will use the SCHISM model to produce the area below 6 PSU that also has a Secchi disk depth of 0.5 m or less (higher turbidity) and water temperature of 23.9 °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 lower Sacramento River region are already relatively well-monitored by routine and long-standing IEP surveys, which collects 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, one at the mouth of Montezuma Slough, one in the eastern region of Grizzly Bay, and one at the Tule Red restoration site. Sondes are calibrated and exchanged per their organization's QAPPs. 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 are collected every two weeks or monthly.

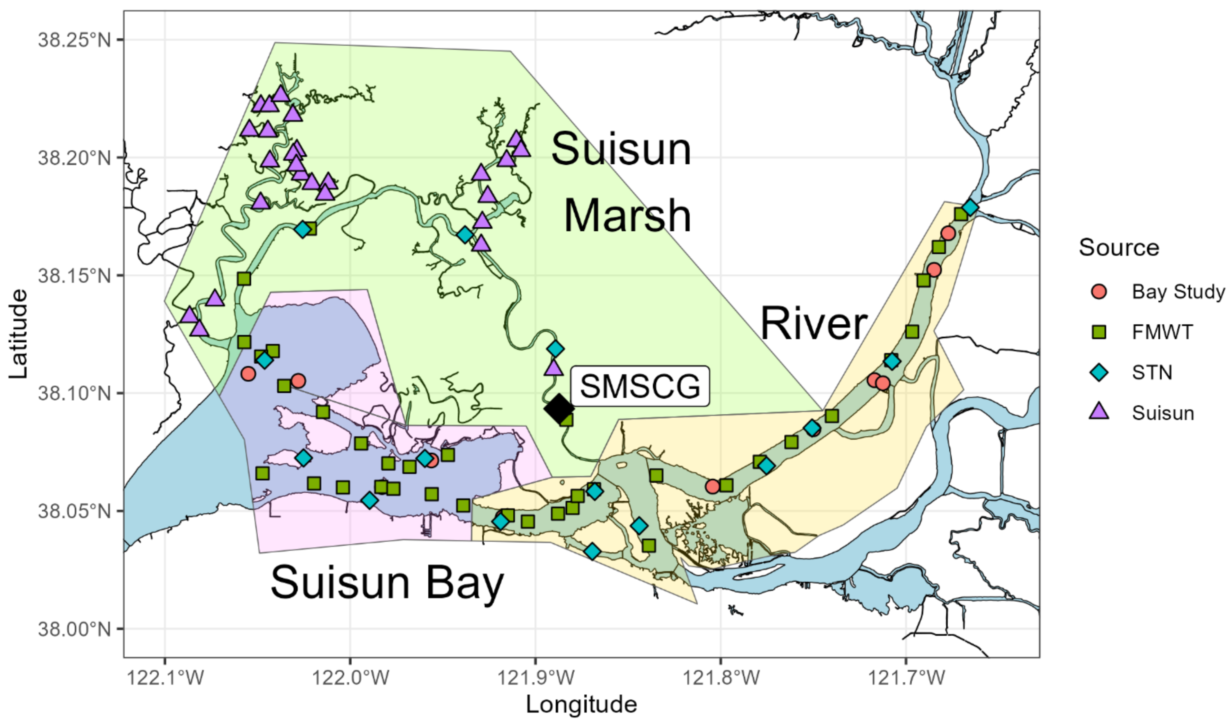
STATION	Owner	Region	LOCATION
CSE*	DWR	River	Montezuma Slough at Collinsville
EMM	USBR	River	Sacramento River at Emmenton
MAL	DWR	River	Sacramento River at Mallard Island
RVB	DWR	River	Rio Vista
MSL*	DWR	Marsh	Montezuma Slough near SMSCG Facility
NSL*	DWR	Marsh	Montezuma Slough at National Steel
BDL*	DWR	Marsh	Montezuma Slough at Belden's Landing
HUN*	DWR	Marsh	Montezuma Slough at Hunter Cut
GZL*	DWR	Grizzly Bay	Grizzly Bay Piling
GZB*	DWR	Grizzly Bay	Grizzly Bay Buoy
RYC	DWR	Grizzly Bay	Ryer Island

STATION	Owner	Region	LOCATION
PCT	DWR	Grizzly Bay	Port Chicago
GZM*	DWR	Grizzly Bay	Mouth of Montezuma
TRB*	DWR	Grizzly Bay	Tule Red Restoration Site near breach

Biological Monitoring

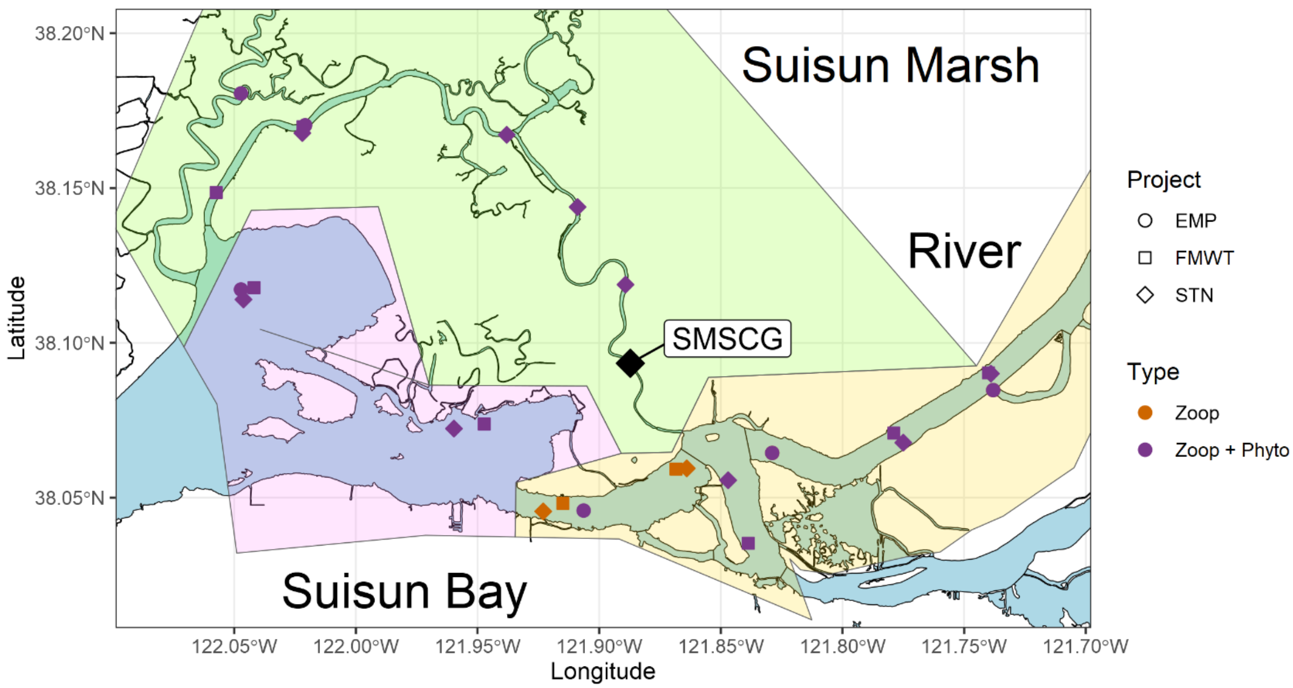
Fish monitoring will rely entirely on existing surveys conducted by IEP, specifically the California Department of Fish and Wildlife (CDFW) Summer Townet Survey (STN), San Francisco Bay Study, and Fall Midwater Trawl Survey (FMWT), as well as the UC Davis Suisun Marsh Survey and the USFWS Enhanced Delta 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 four 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). Previous years also included the USBR Directed Outflow Project (DOP), but this survey is not being conducted in 2023. 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.

Figure 3 **Phytoplankton and Zooplankton sampling locations**



Smelt Cages

The plans for smelt cage deployment are currently being refined, however the plan is to deploy four cages per site, with 60 fish per cage, at three sites: Rio Vista, Beldon's Landing, and Grizzly Bay. The Grizzly Bay site has yet to be scouted, but we will target an area in the 6-7 PSU range during the course of the action. Cages will be deployed in late August or early September and left in for four to six weeks, if issues with biofouling can be overcome. At the end of the six weeks we will measure growth, condition factor, liver glycogen stores, and survival. Other metabolic or diet-based metrics may be added if feasible.

Data analysis:

We will graphically compare 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. If feasible, we will retrospectively model area of appropriate Delta Smelt habitat with three-dimensional hydrodynamic models (SCHISM). 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 100 TAF action or 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 action increased Delta Smelt habitat. If possible, we will also incorporate analyses in the Smith and Nobriga manuscript on impact of prey density on Delta Smelt habitat for a more complete metric of habitat availability.

We will statistically compare biomass of calanoid copepods and other Delta Smelt prey items in the Low Salinity Zone in 2023 versus years with different salinity conditions in Suisun Marsh and Suisun Bay 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 2023 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 2023 and other years with low salinity would support the hypothesis that operating the X2 increases food availability for Delta Smelt.

We do not anticipate enough catch of Delta Smelt in the EDSM survey to statistically analyze changes in Delta Smelt abundance 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 X2 and SMSCG actions.

We will statistically compare growth, condition factor, and liver glycogen stores between the three cage deployments using an generalized linear models, ANOVA, or non-parametric equivalents. Greater growth, higher condition factor, or higher glycogen stores at the Belden’s Landing site would support the hypothesis that habitat in Suisun Marsh is superior to habitat further upstream or outside the low salinity zone.

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 2024. 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 Fall X2, 100 TAF, and SMSCG actions, refine structured decision-making performance measures, and enhance the adaptive management of the Summer-Fall Habitat Action in 2024.

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