

Selenium Workgroup 2020 Proposal #2: Selenium in North Bay Clams and Water

Summary: The proposed clam monitoring would continue a long-running USGS monitoring program for selenium in clam tissue. The RMP approved funding in 2017 that enabled monitoring to continue through September 2017, and then a continuation of the monitoring in 2019. This proposal would support a second year of monitoring following a modified monitoring design optimized for early detection of changes in selenium trends in clams. Clam and concurrent water samples would be collected monthly at two locations in two three-month blocks (Jun-Aug and Nov-Jan).

Estimated Cost

Monitoring: \$73,160

Data Management and Reporting: Will be funded in 2021 to cover three years of data.

Oversight Group: RMP Selenium Workgroup

Proposed by: Nina Buzby and Jay Davis

Time Sensitive: Yes

PROPOSED DELIVERABLES AND TIMELINE

Deliverable	Due Date
Task 1. Collect water and clam samples	Jun 2020 – Jan 2021
Task 2A. Analyze water samples	Complete by May 2021
Task 2B. Analyze clam samples	Complete by May 2021
Task 3. Data Management	June 2021
Task 4. Draft Report	Dec 2021
Task 5. Final Report	Feb 2022

Background

In 2016, the State Water Resources Control Board approved a selenium TMDL for North San Francisco Bay. The TMDL established a target concentration of 11.3 µg/g dw in white sturgeon muscle tissue as the basis for evaluating impairment (SFBRWQCB 2015). In June 2016, the USEPA published proposed aquatic life and aquatic-dependent wildlife criteria for selenium in the Bay and Delta. The proposal includes criteria for fish tissue (muscle and whole body), clam tissue, and water (dissolved and particulate phases).

After establishing the North Bay TMDL, the San Francisco Water Board asked the Selenium Workgroup to develop a robust monitoring design for the North Bay. The goal is to identify leading indicators of change to allow prompt management response to signs of increasing impairment. The Workgroup convened a technical workshop on this topic on July 27, 2016. At this workshop, participants reached a consensus that monitoring of sturgeon, clams, and water are needed to answer management questions. Recommendations for long-term monitoring of these three matrices are presented in the North Bay Monitoring Design document (Grieb et al. 2018).

USGS conducted monthly clam monitoring at multiple locations in North Bay for over 20 years, but USGS funding for this work ended in 2016. In 2016, the RMP approved the use of Undesignated Funds to support continuation of the USGS monitoring, which covered monitoring through September 2017. Since October 2017, clams have not been monitored in North Bay, creating the first gap in this long-term time series. In 2019, the RMP will resume clam monitoring following a modified monitoring design optimized for early detection of changes in selenium trends in clams. Following the recommendations in the North Bay Monitoring Design document (Grieb et al. 2018), this monitoring is proposed to be continued on an annual basis.

There is currently no systematic monitoring program for dissolved and particulate selenium in the water column in North Bay. Previously, studies of selenium speciation across the estuarine salinity gradient were conducted only periodically in 1999-2000, 2010, and 2012; currently, only dissolved selenium is collected at randomly selected sites in North Bay once every two years through the RMP's Status and Trends Water Cruise. Recommendations in Grieb et al. (2018) for future water monitoring included monthly water sampling at the two clam stations in North Bay for three years. The Clam and Water study funded by the RMP in 2019 includes water sampling concurrent with clam sampling at the two primary USGS long-term monitoring stations (4.1 and 8.1) in two three-month blocks (Jun-Aug and Nov-Jan).

Study Objectives and Applicable RMP Management Questions

The objective of this monitoring element is to continue long-term monitoring of clams (*Potamocorbula amurensis*) and begin long-term monitoring of water in North Bay. These samples will be used to track long-term interannual trends and provide an indication of changes in sources or environmental processes influencing food web selenium exposures in North Bay. This study addresses key questions identified by the Selenium Strategy and the RMP (Table 1).

Table 1. Study objectives and questions relevant to RMP management questions.

RMP Management Question	Priority Management Question for Selenium	Priority Management Question for Selenium in North Bay	Study Objective	Example Information Application
1. Are chemical concentrations in the Estuary at levels of potential concern and are associated impacts likely?	2. Are the beneficial uses of north San Francisco Bay impaired by selenium?	1. Are the beneficial uses of north San Francisco Bay impaired by selenium?	Compare measured concentrations to the North Bay TMDL target for water and USEPA selenium criteria for water and clams.	Do the data indicate a need for management actions? What factors are influencing the observed selenium concentrations?
2. What are the concentrations and masses of contaminants in the Estuary and its segments?	3. What is the spatial pattern of selenium impairment?		Compare measured concentrations across two sites in North Bay.	Are there distinct differences in selenium concentrations and patterns across sites? What do these differences indicate about selenium sources and bioaccumulation in different regions of North Bay?
4. Have the concentrations, masses, and associated impacts of contaminants in the Estuary increased or decreased?	2. Are changes occurring in selenium concentrations that warrant changes in management actions?	2. Are changes occurring in selenium concentrations that warrant changes in management actions?	Compare measured concentrations to clam and water concentrations measured during past studies. Evaluate trends using change point and normal range analyses.	Are selenium concentrations increasing or decreasing? What factors may be influencing these trends?

Approach

Field Sample Collection

Potamocorbula amurensis and water samples will be collected from two long-term USGS monitoring locations in northern San Francisco Bay: (1) station 4.1 near the confluence of the Sacramento and San Joaquin Rivers, and (2) station 8.1 at the mouth of the Carquinez Strait in Suisun Bay. Samples will be collected and processed by Applied Marine Sciences aboard the *R/V Questuary*. Clam sampling will take place during six months each year. The recommended sampling design includes two key three-month periods of monthly sampling preceding fall fish muscle plug monitoring (July-September) and sturgeon spring pre-spawning period (December-February).

Each month, approximately 80-100 clams will be collected from each site using a benthic ponar grab and depurated for 48 hours prior to being measured and divided into five composite replicates representing a range in clam lengths from 8-15 mm. Groups of composite clam samples will be shipped to the analytical laboratory for further sample processing and analysis.

Water sampling will take place concurrent with clam sampling. Samples will be collected from the same two sites, using a peristaltic pump. Both the dissolved and particulate phases will be analyzed. Sample collection methods, including sample volumes and filter sizes will be established during a proposed laboratory intercomparison study conducted prior to the sampling.

Laboratory Analyses

Clams will be dissected and homogenized into five composite samples by the analytical lab. A wet weight will be recorded before the samples are oven dried at $< 40^{\circ}\text{C}$, after which a dry weight will be recorded and samples will be analyzed for selenium concentrations. Samples will also be prepared for analysis of carbon and nitrogen stable isotopes by UC Davis stable isotope facility.

Clams will be analyzed in two batches, one for each sampling round. At least one method blank, one standard reference material, two laboratory duplicates, and two matrix spikes will be analyzed with every 20 samples. The analytical laboratory will be determined following the proposed laboratory intercomparison study.

The analytical laboratory for dissolved and particulate water samples, and corresponding sample processing and analytical methods, will similarly be determined following the proposed laboratory intercomparison study. Ancillary parameters, including total suspended material, total organic carbon, and chlorophyll a will also be collected with each selenium sample.

Budget

The proposed budget for monitoring is \$73,160. This includes project planning, sample collection, laboratory analyses, and preliminary data review.

Data management and reporting (\$40,000) will be performed in 2021 on the three-year dataset. This will include complete RMP data management and reporting, including data upload to CEDEN.

Table 2. Monitoring Budget

Task	Estimated Cost
<i>Labor</i>	
Project Planning and Coordination	\$5,000
Data Management	\$4,000
<i>Subtotal</i>	<i>\$9,000</i>
<i>Subcontracts</i>	
AMS – clam and water sample collection and processing, 6 months	\$28,925
BAL ¹ – 60 clam samples processed and subsampled @ \$50/sample	\$3,000
BAL ¹ – 60 selenium and total solids analyses in clams @ \$100/sample	\$6,000
BAL ¹ – 6 months of dissolved and particulate selenium analyses in water @ \$530/month (\$110, \$155/sample)	\$5,280
BAL ¹ – 12 samples of TSS, TOC, chla @ \$80, \$85, \$180/sample	\$4,140
UCD – 60 ¹³ C and ¹⁵ N stable isotope analyses in clams @ \$9/sample	\$540
<i>Subtotal – With Water</i>	<i>\$47,885</i>
<i>Direct Costs</i>	
Vessel	\$15,000
Shipping	\$1,000
Travel	\$275
<i>Subtotal</i>	<i>\$16,275</i>
<i>Grand Total</i>	<i>\$73,160</i>

1 –BAL has a minimum sample size of 8 samples per batch.

References

Grieb, T., S. Roy, J. Rath, R. Stewart, J. Sun, and J.A. Davis. 2018. North Bay Selenium Monitoring Design. San Francisco Estuary Institute, Richmond, CA. SFEI Contribution #921.

San Francisco Bay Regional Water Quality Control Board (SFBRWQCB). 2015. Total Maximum Daily Load Selenium in North San Francisco Bay: Staff Report for Proposed Basin Plan Amendment. Report prepared for the California Regional Water Resources Control Board, San Francisco Bay Region, November 2015. San Francisco Bay Regional Water Quality Control Board, Oakland, CA. http://www.waterboards.ca.gov/sanfranciscobay/board_info/agendas/2015/November/6_appendix_c.pdf